



JCET



AIRS Methane Data for Siberia: Present and Future.

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**Joint Center for Earth System Technology, University of
Maryland Baltimore County**

**Acknowledgements to AIRS Science team members, also to
Mikhail Arshinov (Tomsk Institute of Atmospheric Optics),
Mikhail Glagolev (Moscow University), and Vyacheslav
Zakharov (Ural State University)**

**Supported by NASA AIRS, EOS Validation, and Tropospheric Chemistry Programs
Atmospheric Sounding Science Team Meeting, October 15, 2008, MARRIOTT GREENBELT**

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Outline

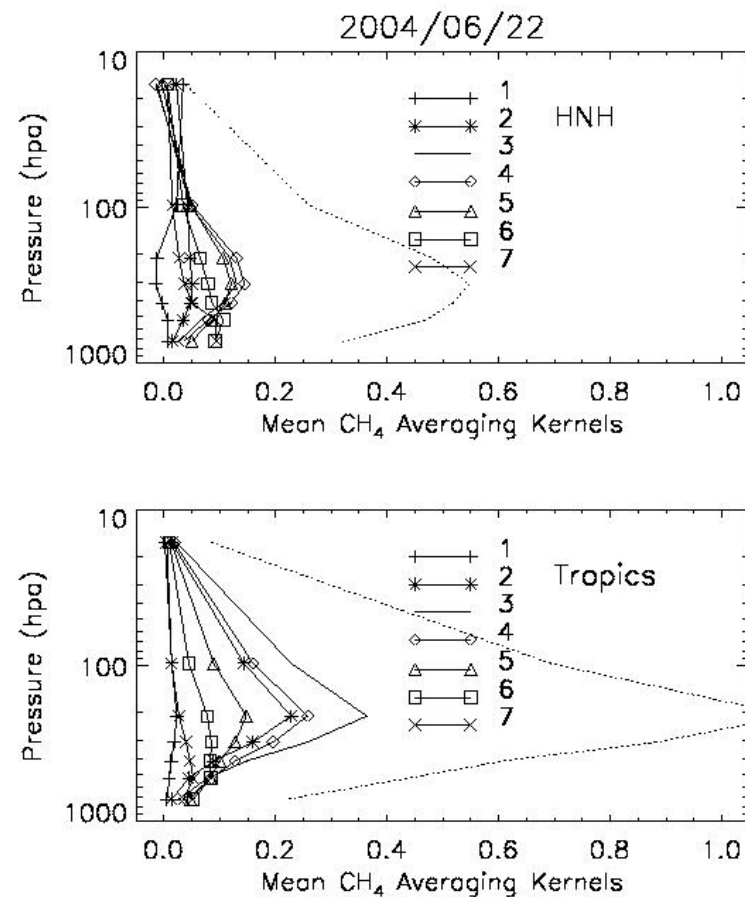
- **Standard AIRS CH₄ v.5 level 3 product for N. Eurasia and N. America**
- **Comparison with SCIAMACHY**
- **Topography effect in winter- spring**
- **Seasonal changes of CH₄ content**

Future possibilities:

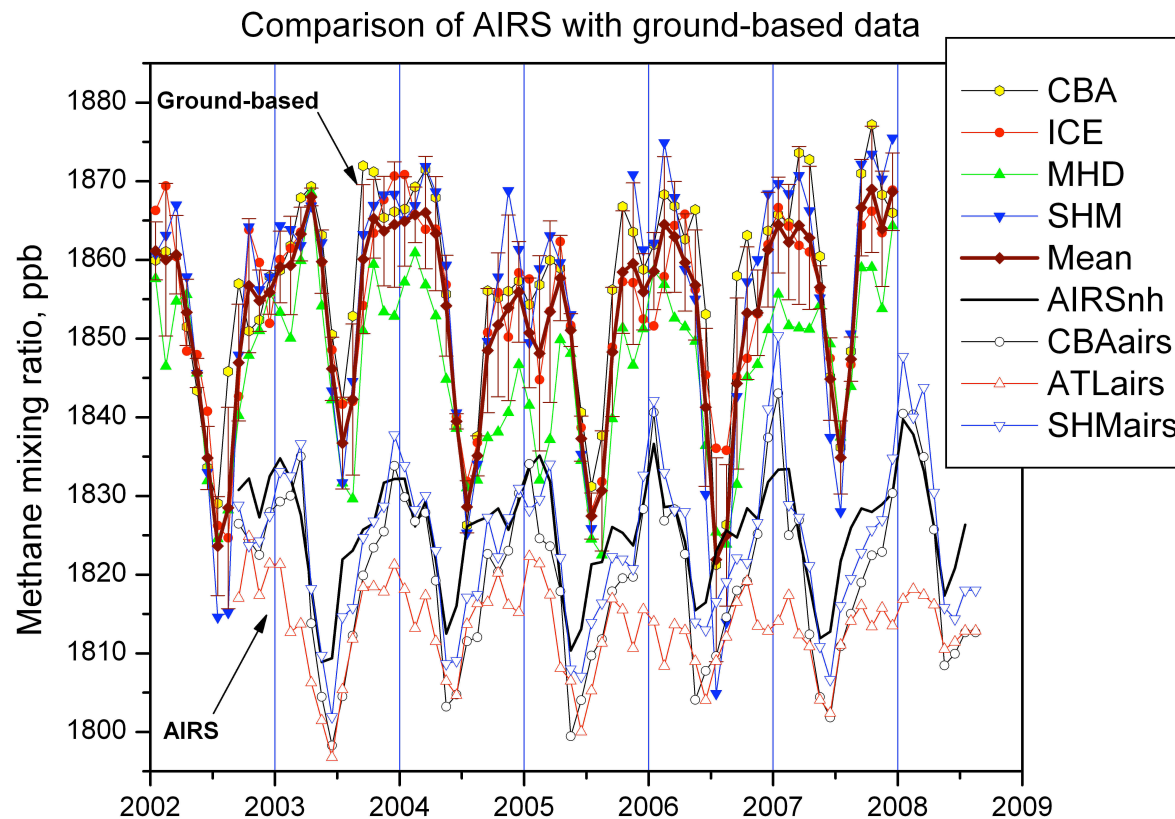
- **Using local Russian data from the bottom for interpretation of AIRS CH₄ and CO₂**
- **Total columns from FTIR in Siberia**

AIRS CH₄ Averaging Kernels

(by X. Xiong et al., J. Geophys. Res. –B, 2008)



CH₄ seasonality near the surface and in the free troposphere over Atlantic and Pacific



CBA – Alaska

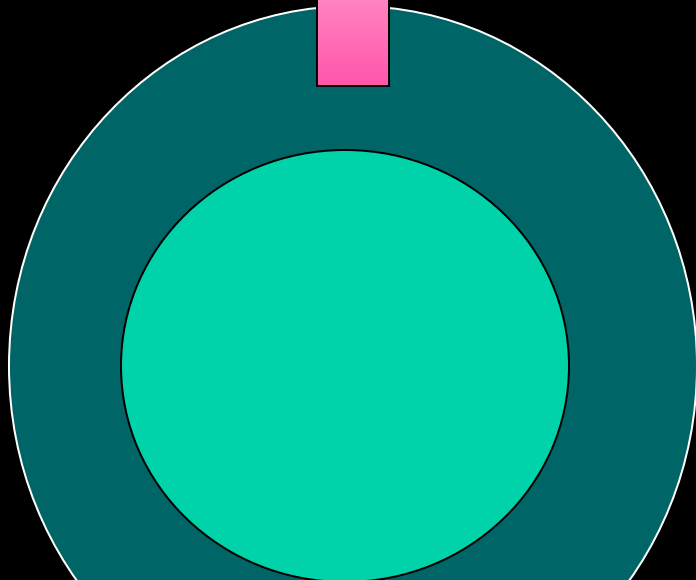
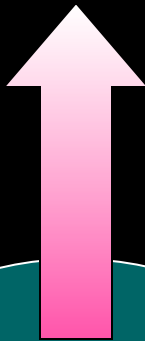
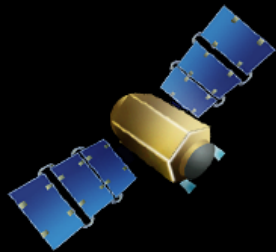
ICE – Iceland

SHM – Pacific

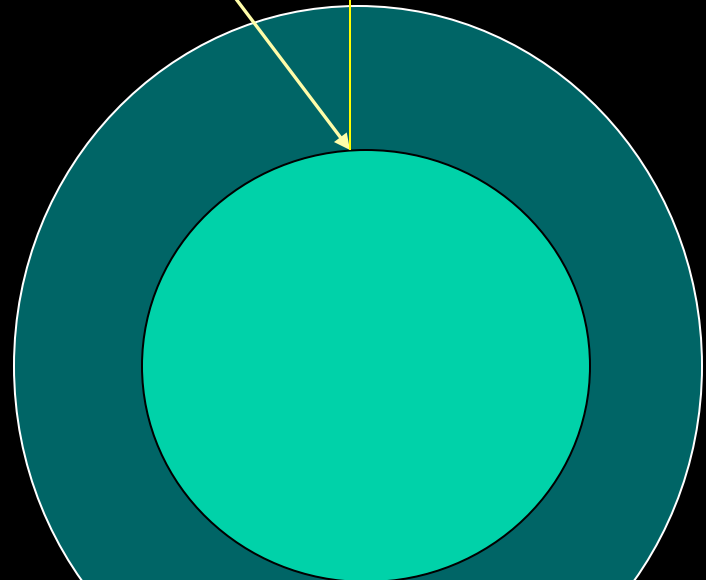
MHD – Ireland

A bias ~ 30 ppb

AIRS (7.66 μm)



SCIAMACHY (1.65 μm)

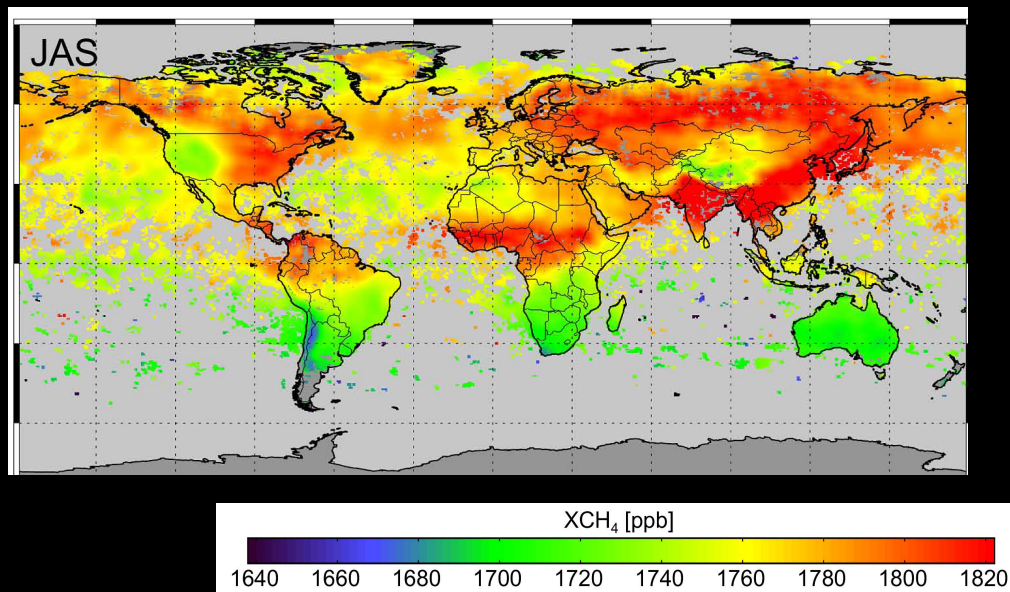
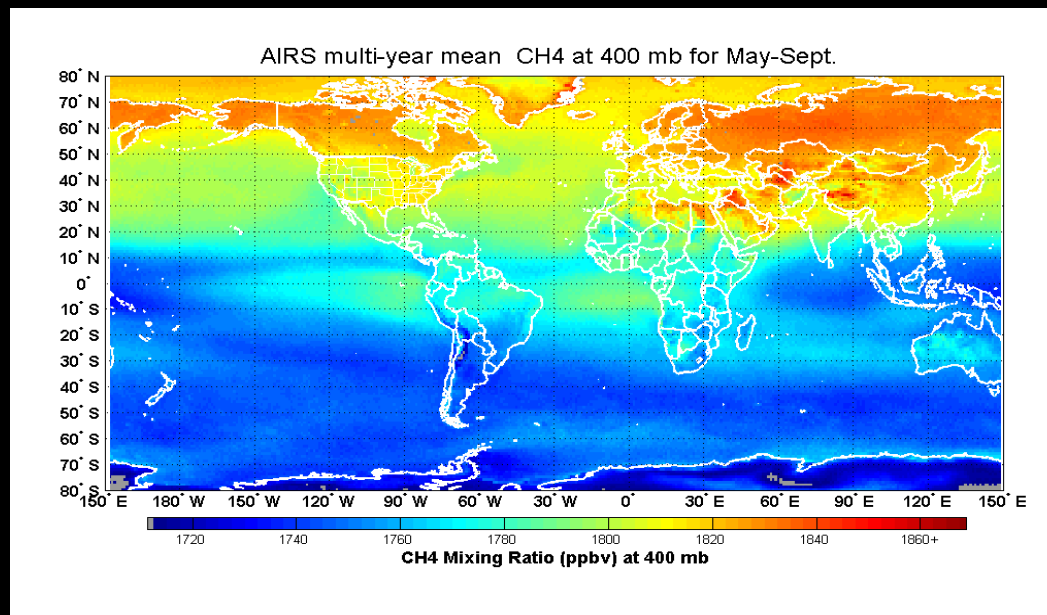


Mixing ratios in the troposphere

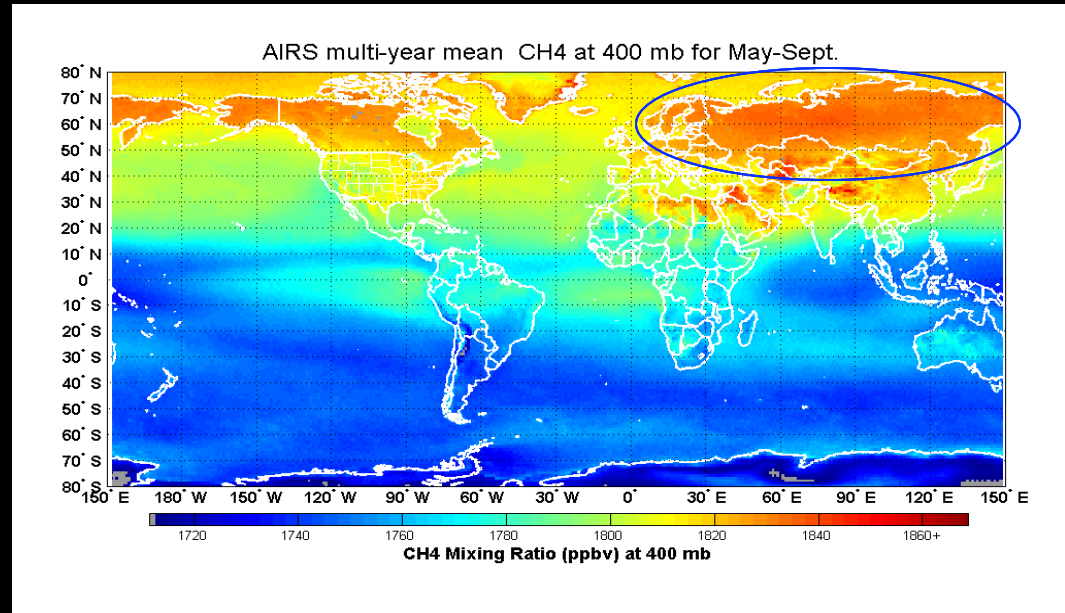
AIRS (FT)
(May - September)
[L3 downloaded]

NH bias ~ 40 ppb or 2%
(AIRS values are
higher, not lower,
as could be expected)

SCIAMACHY (FT+BL)
(July - September)
[Schneising et al., ACPD,
2008]

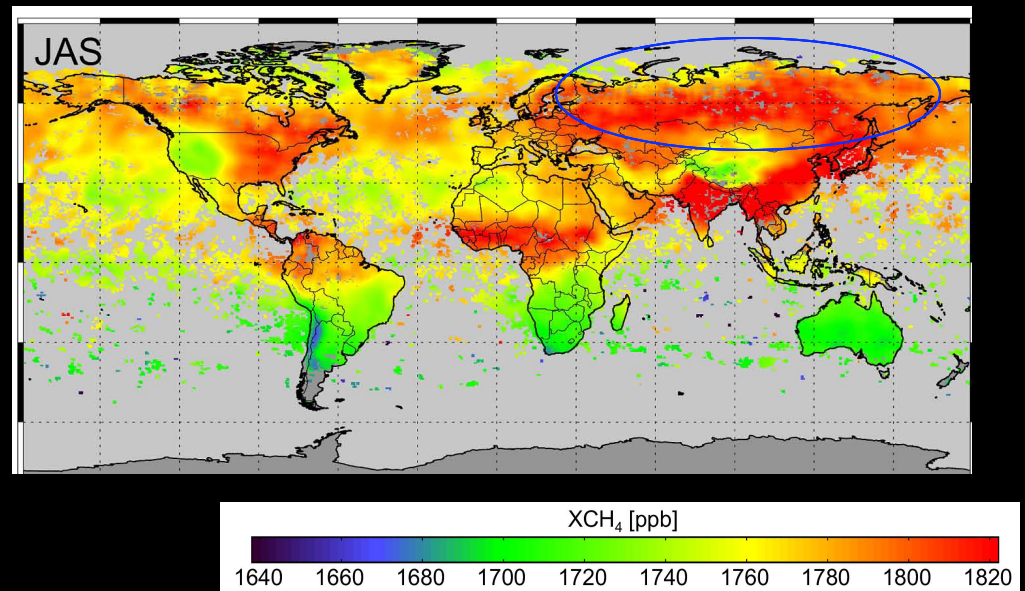


AIRS (FT)
(May - September)
[downloaded]

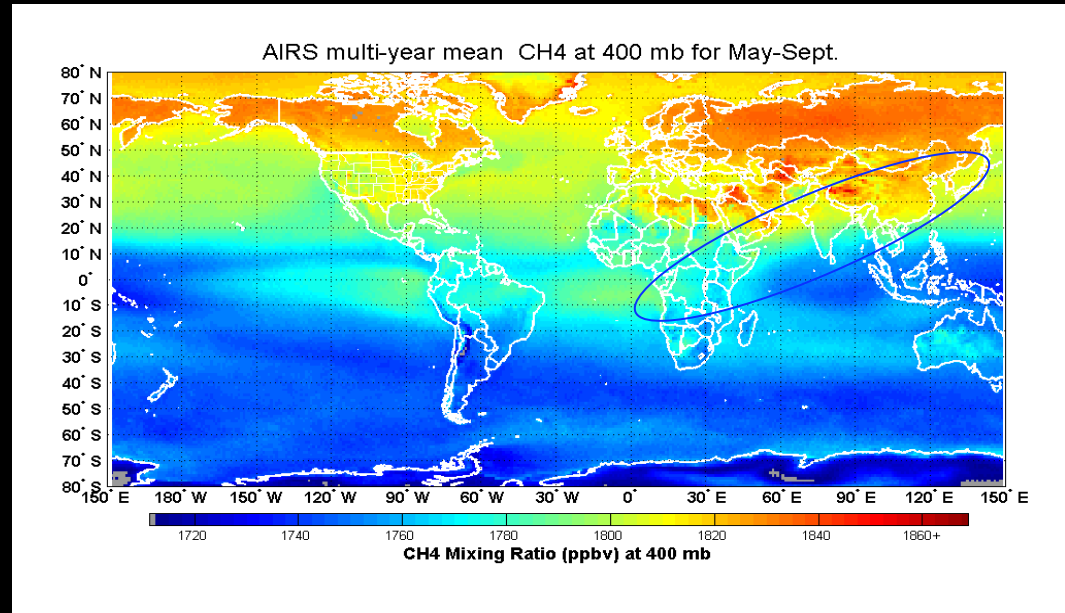


North Eurasia

SCIAMACHY (FT+BL)
(July - September)
[Schneising et al., ACPD,
2008]



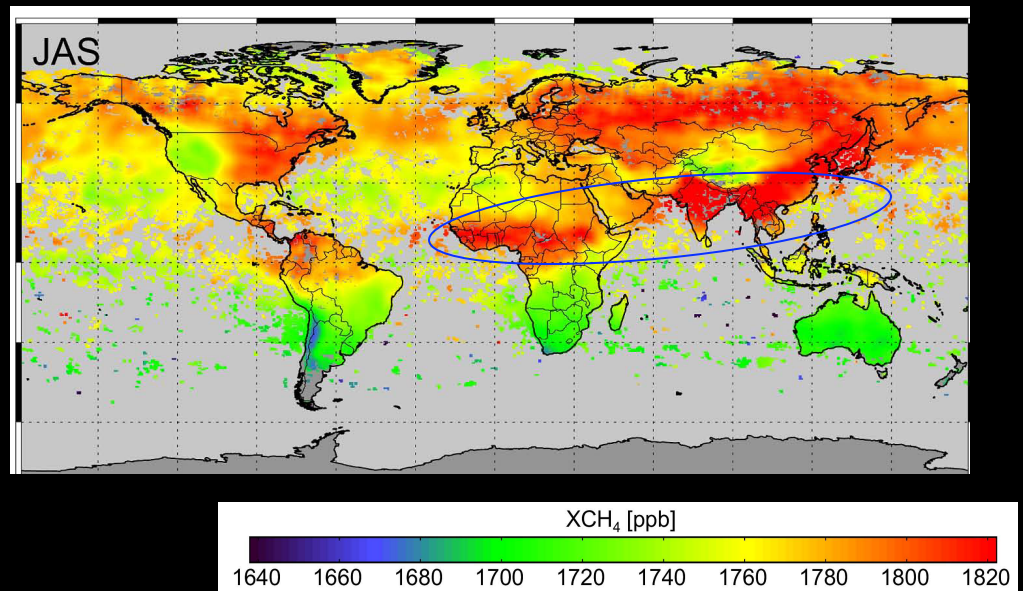
AIRS (FT) (May - September) [downloaded]



Africa, India, China



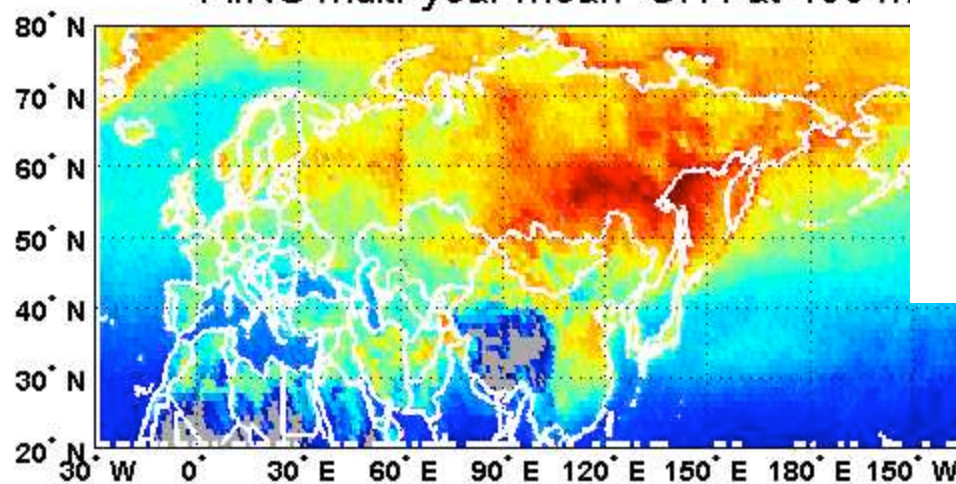
SCIAMACHY (FT+BL)
(July - September)
[Schneising et al., ACPD,
2008]



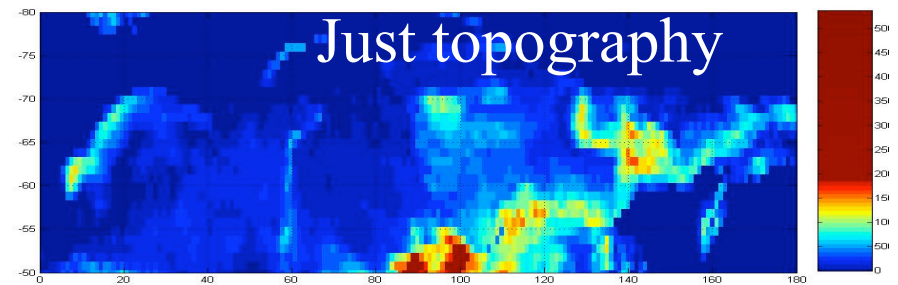
AIRS winter time errors connected with
topography

AIRS in winter time (January): topography effect

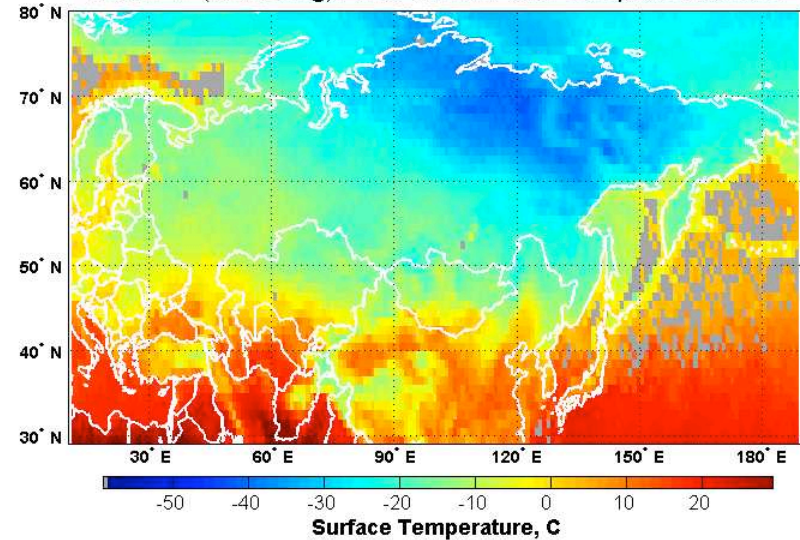
AIRS multi-year mean CH₄ at 400 m^h for mean 2004



Just topography

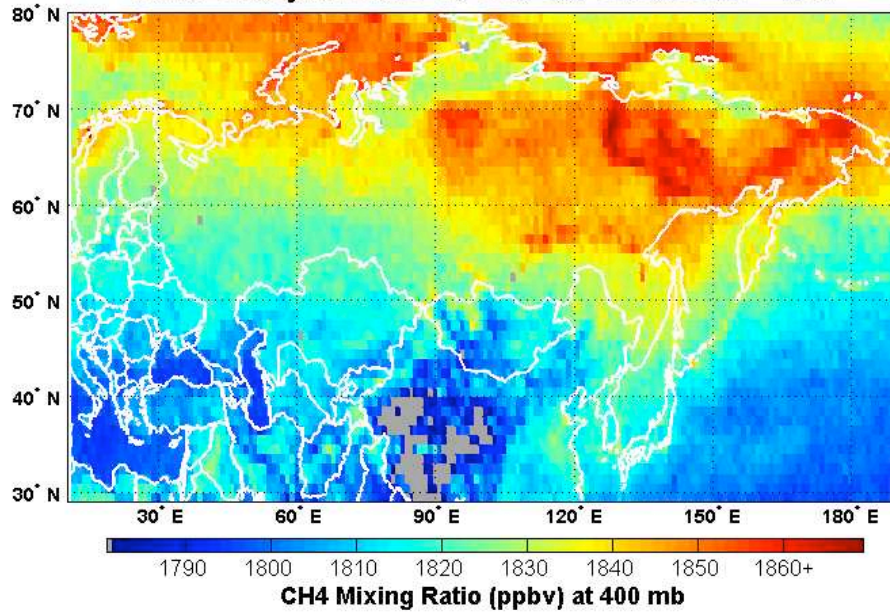


Local PM (ascending) AIRS Surface Skin Temp. on 2004.01.

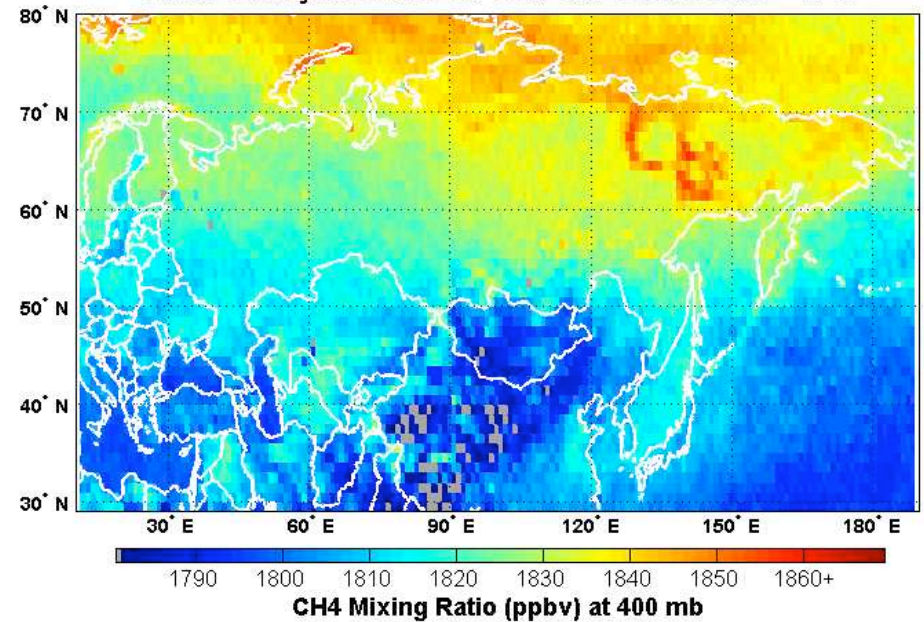


AIRS in spring time (March and April)

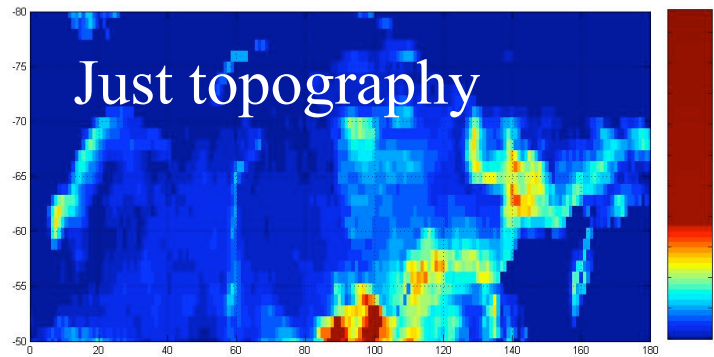
AIRS multi-year mean CH₄ at 400 mb for mon= .03.



AIRS multi-year mean CH₄ at 400 mb for mon= .04.

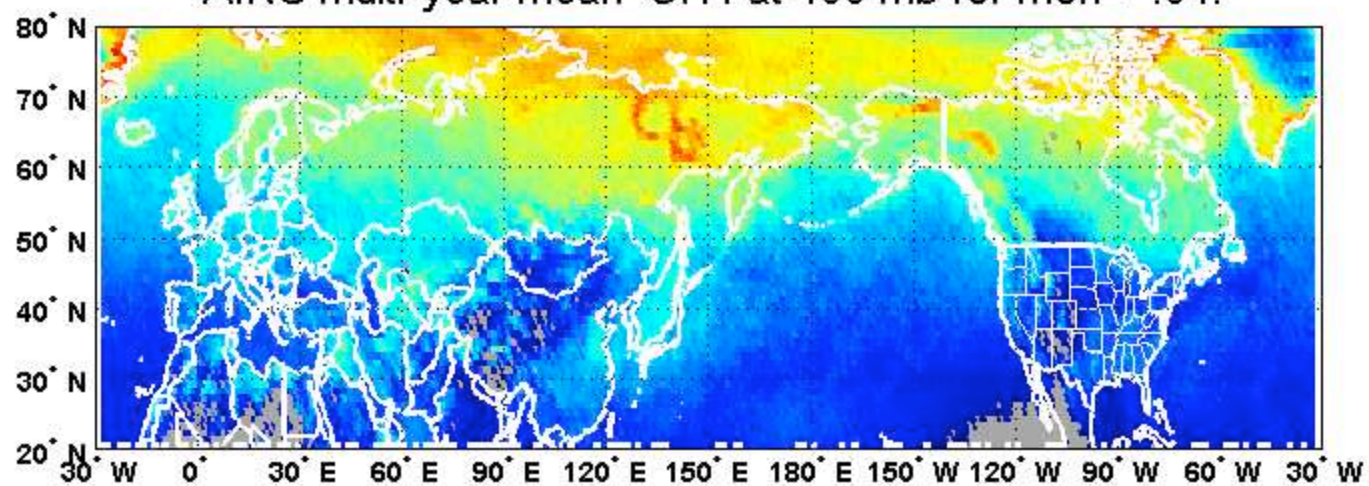


Just topography

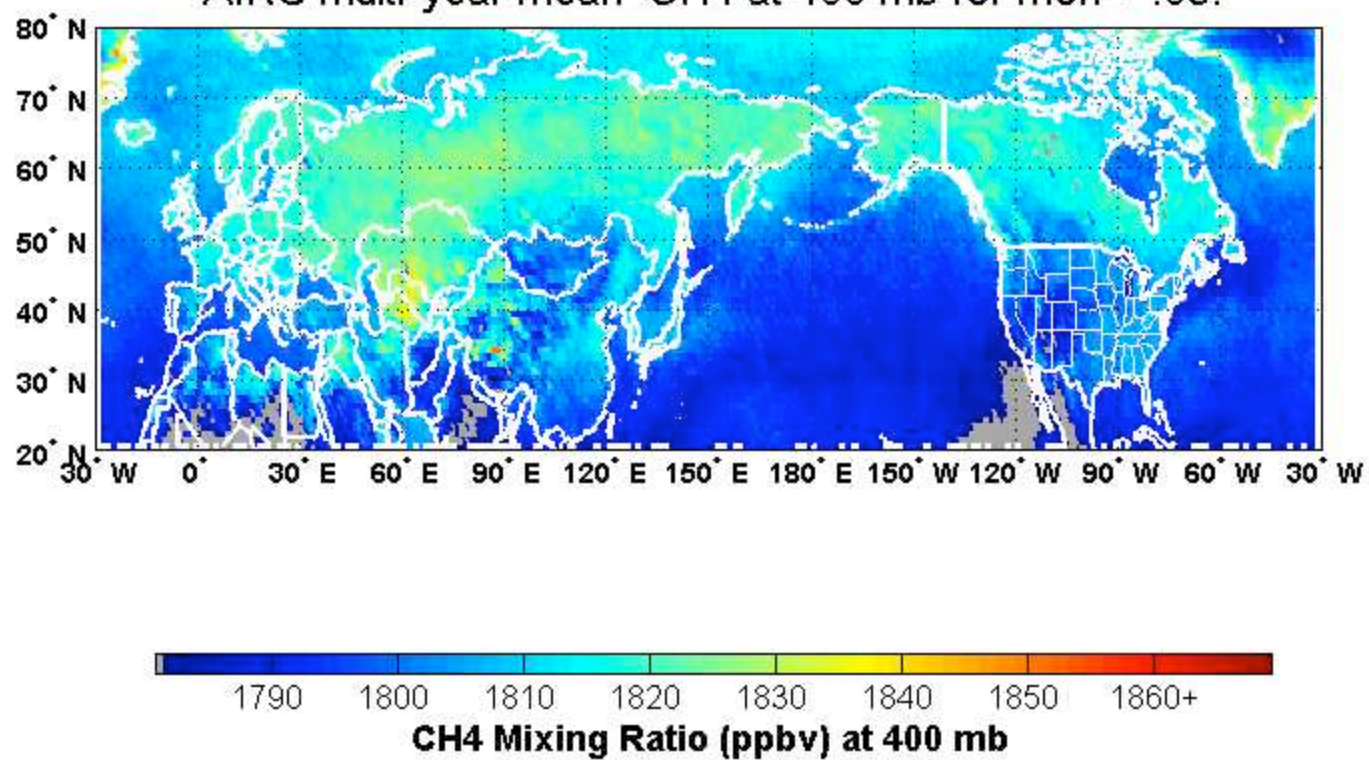


Monthly
AIRS, 2003-2007 averaging

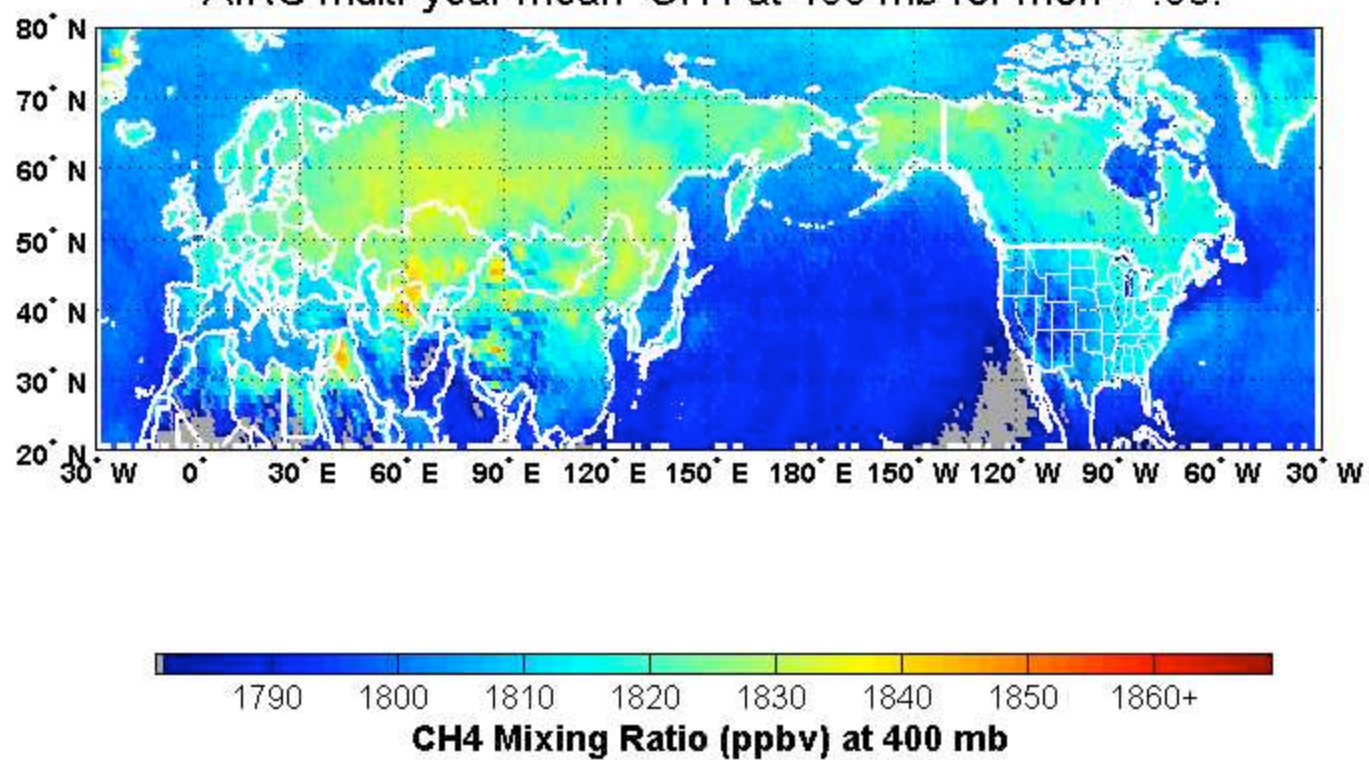
AIRS multi-year mean CH₄ at 400 mb for mon= .04.



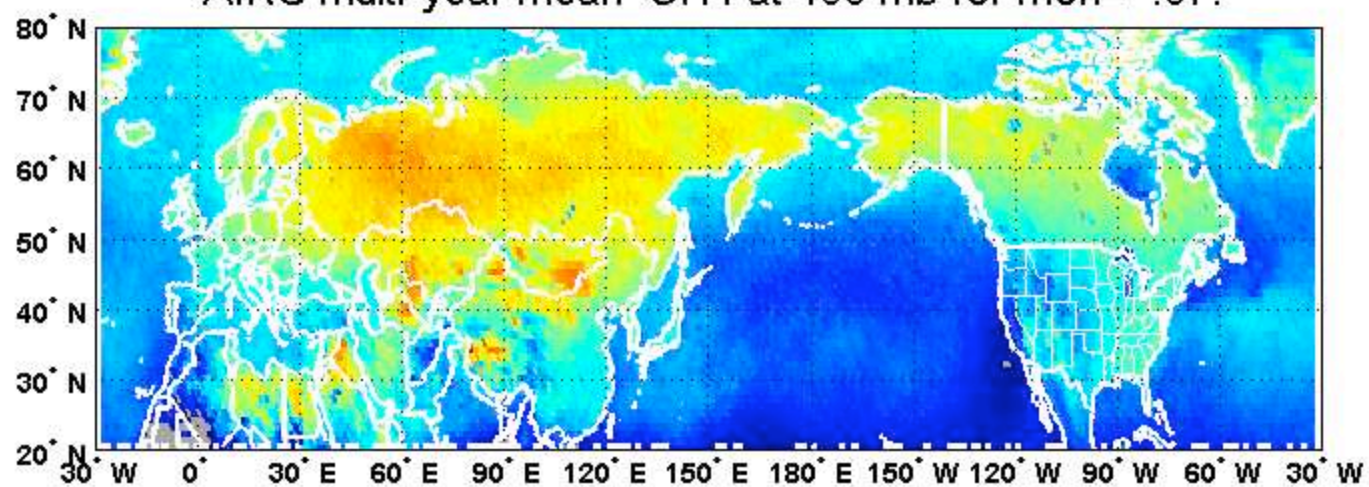
AIRS multi-year mean CH₄ at 400 mb for mon= .05.



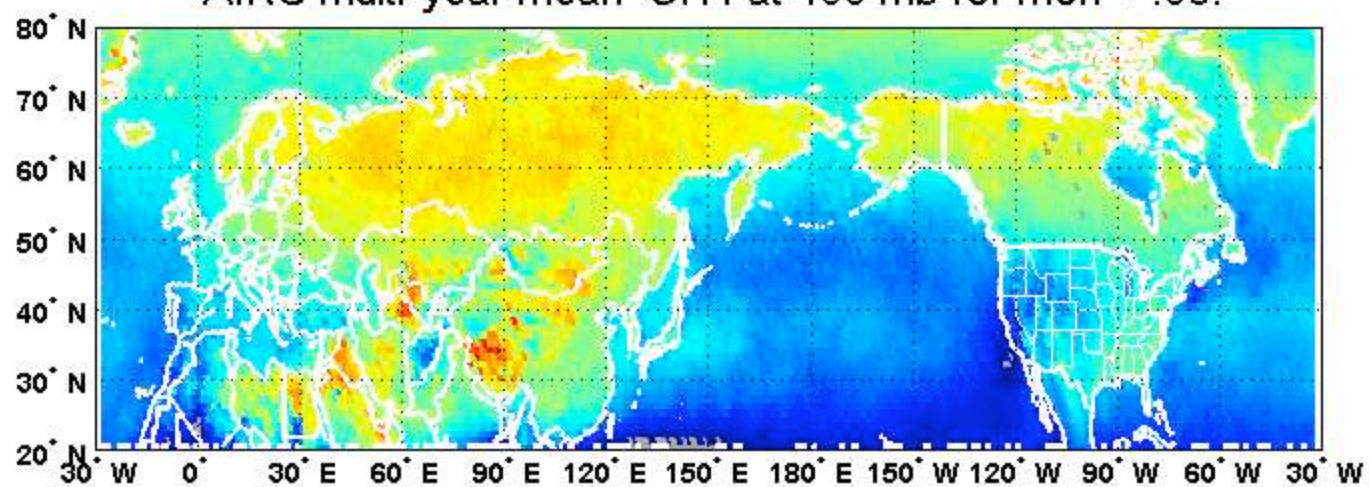
AIRS multi-year mean CH₄ at 400 mb for mon= .06.



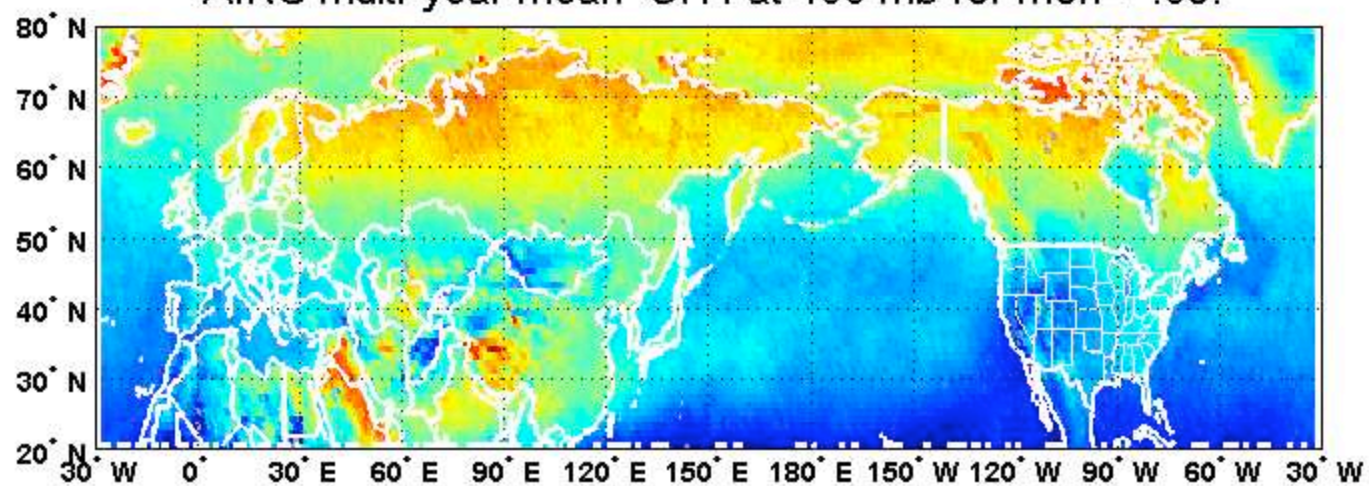
AIRS multi-year mean CH₄ at 400 mb for mon= .07.



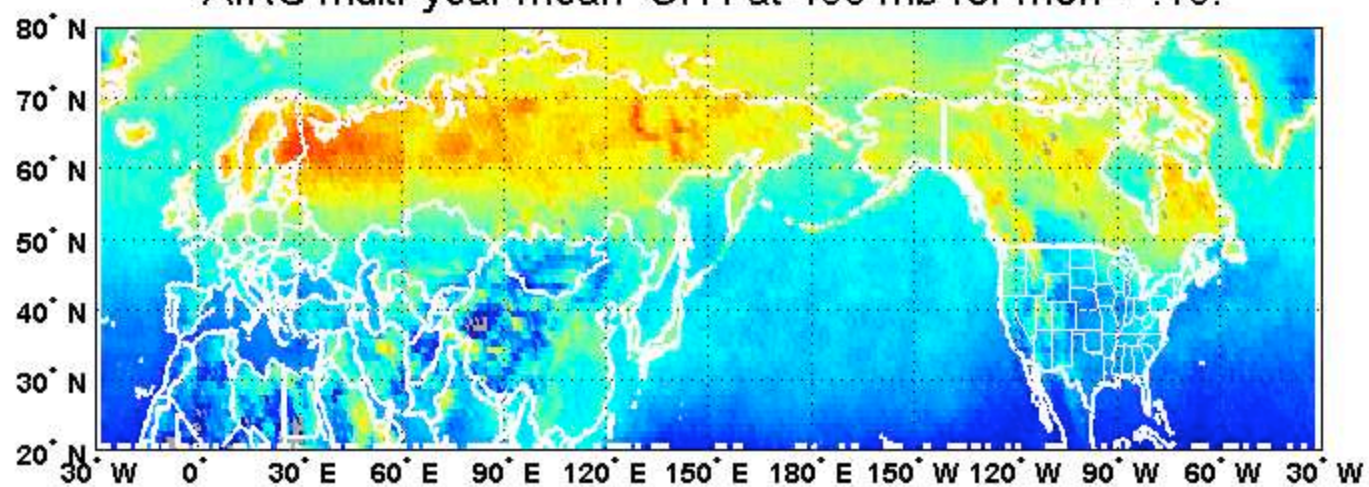
AIRS multi-year mean CH₄ at 400 mb for mon= .08.



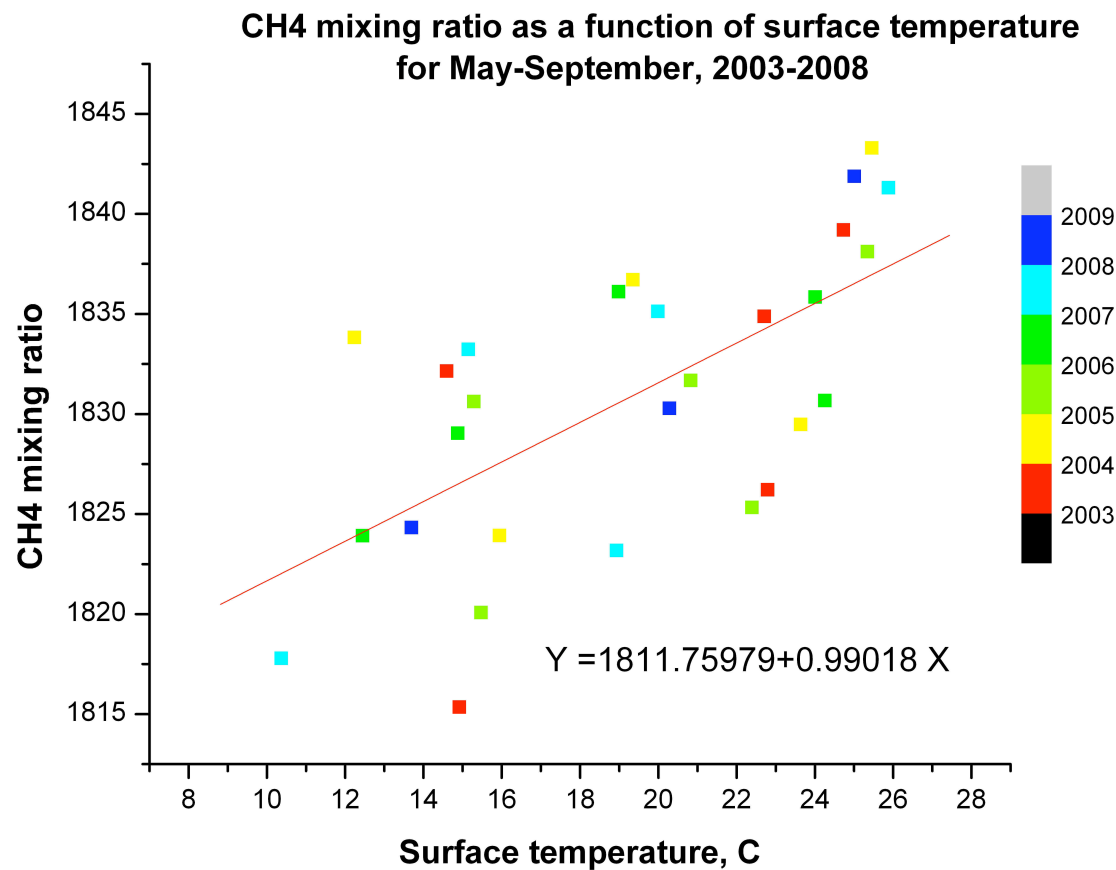
AIRS multi-year mean CH₄ at 400 mb for mon= .09.



AIRS multi-year mean CH₄ at 400 mb for mon= .10.



May - September methane in West Siberia: correlation with surface skin temperature

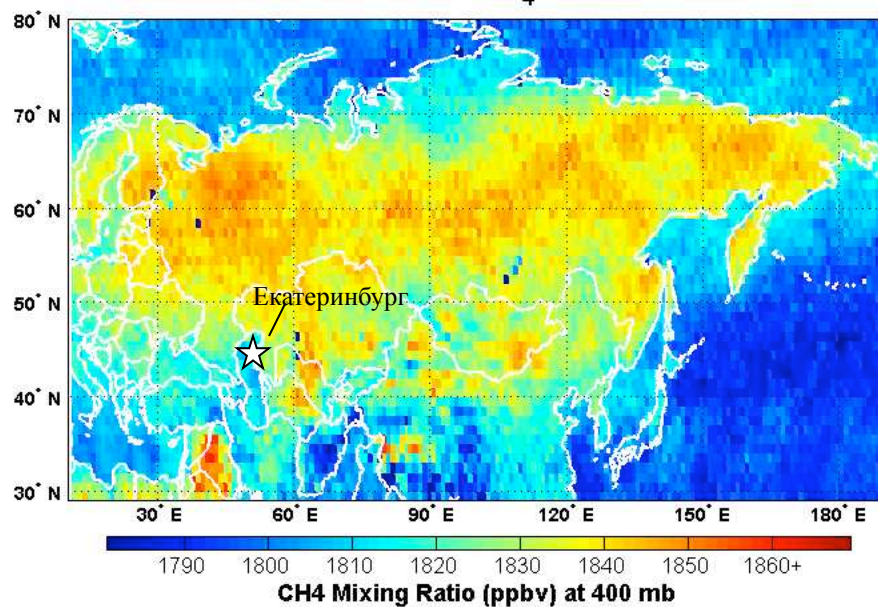


Interannual variations

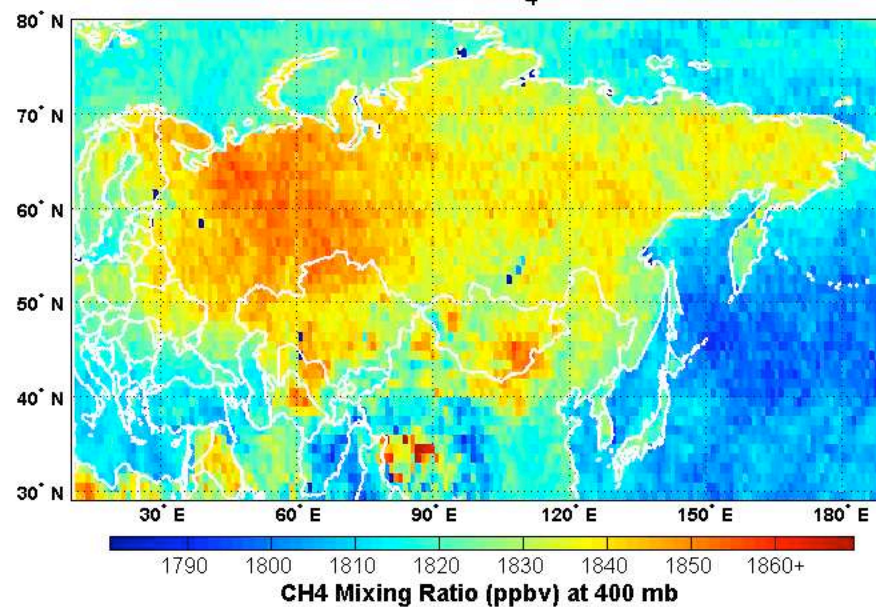
CH₄ in July between 2003 and 2008:

Soil Bacteria (??)

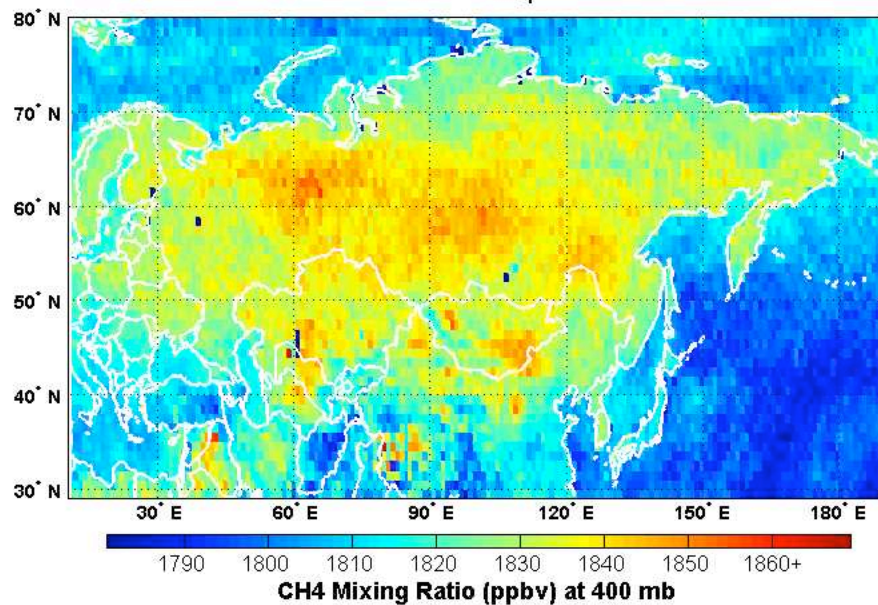
Local PM (ascending) AIRS CH₄ at 400 mb on 2003.07.



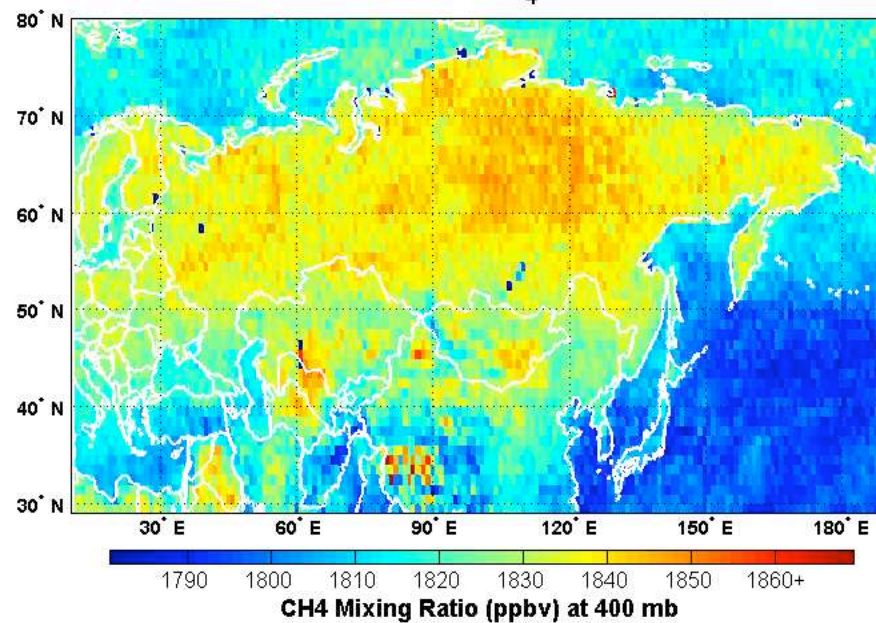
Local PM (ascending) AIRS CH₄ at 400 mb on .2004.07



Local PM (ascending) AIRS CH₄ at 400 mb on 2005.07.

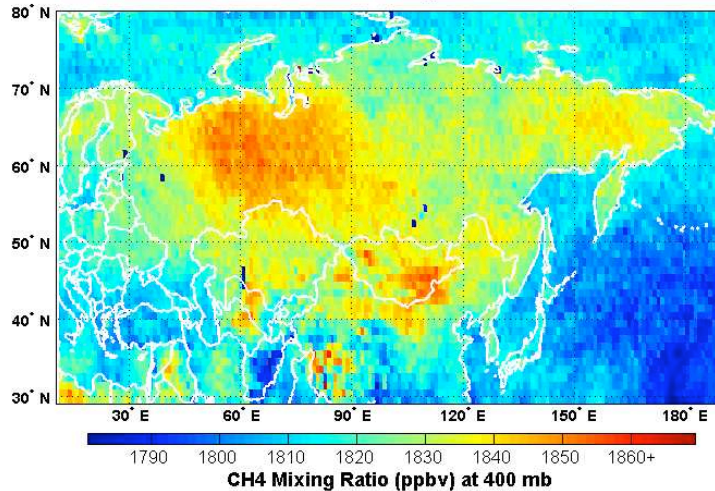


Local PM (ascending) AIRS CH₄ at 400 mb on 2006.07.

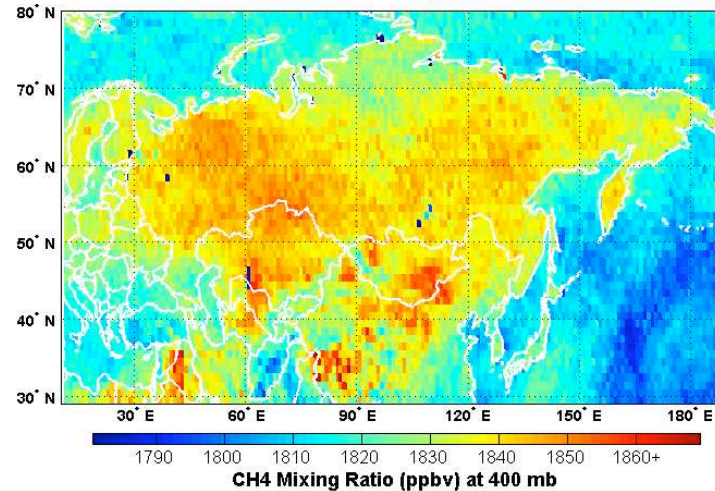


July methane in 2007 and 2008

Local PM (ascending) AIRS CH₄ at 400 mb on 2007.07.

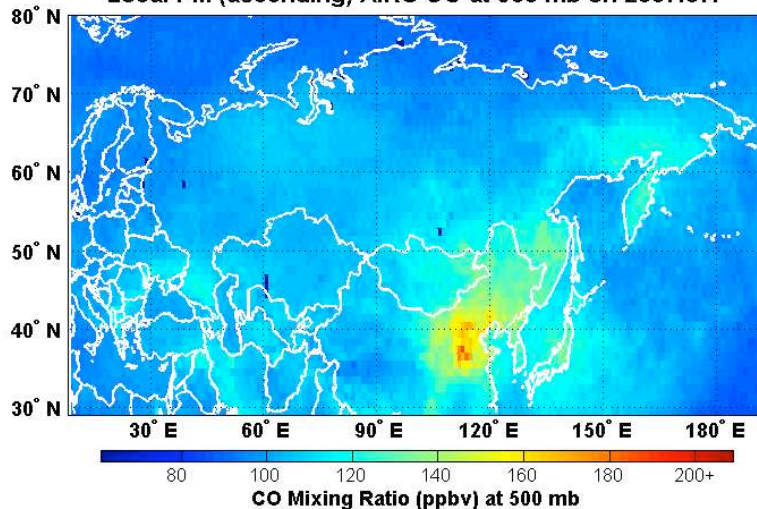


Local PM (ascending) AIRS CH₄ at 400 mb on 2008.07.

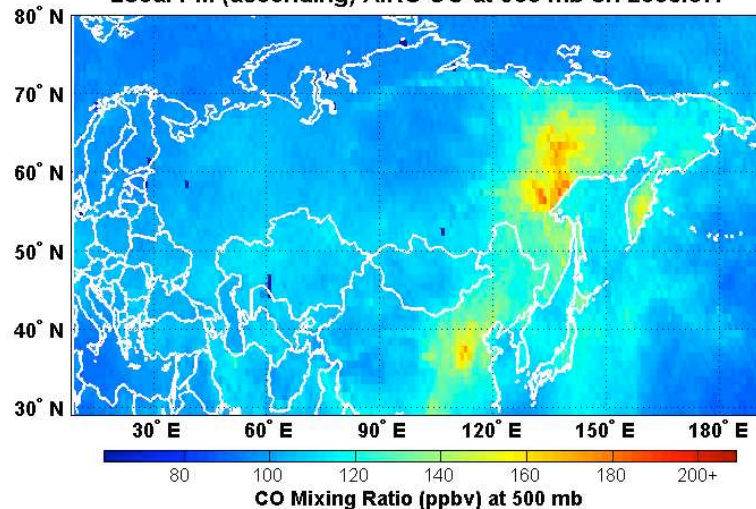


July CO in 2007 (no fires) and 2008 (fires) for comparison

Local PM (ascending) AIRS CO at 500 mb on 2007.07.

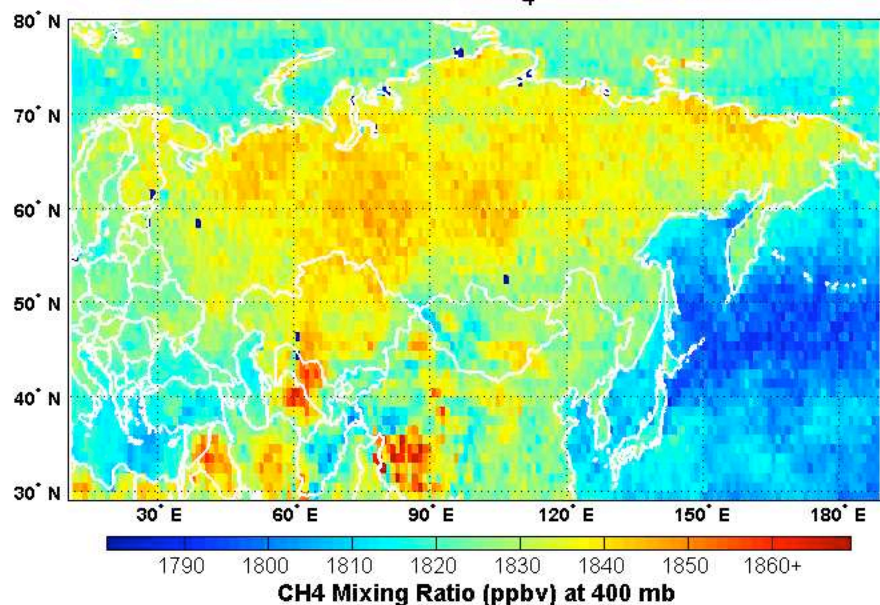


Local PM (ascending) AIRS CO at 500 mb on 2008.07.

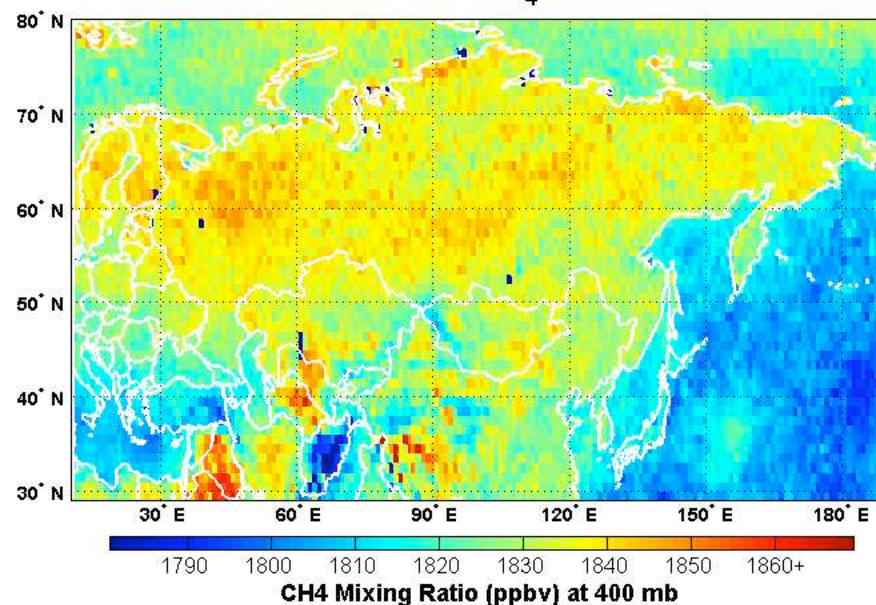


CH₄ in August between 2003 and
2008

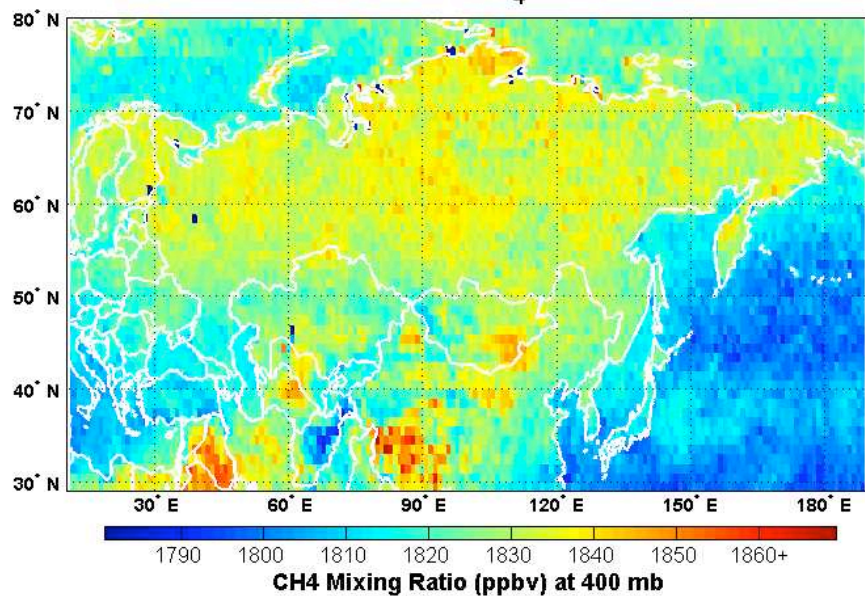
Local PM (ascending) AIRS CH₄ at 400 mb on 2003.08.



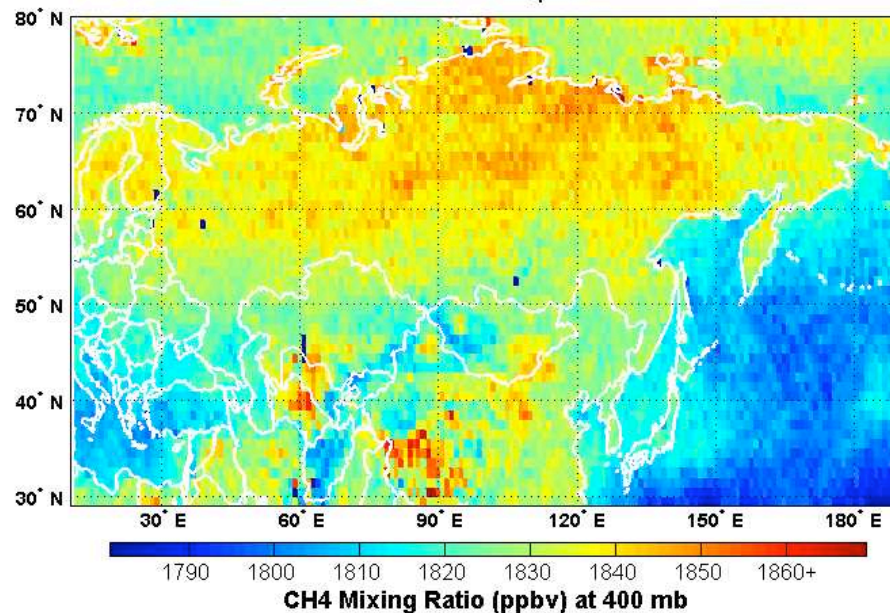
Local PM (ascending) AIRS CH₄ at 400 mb on .2004.08



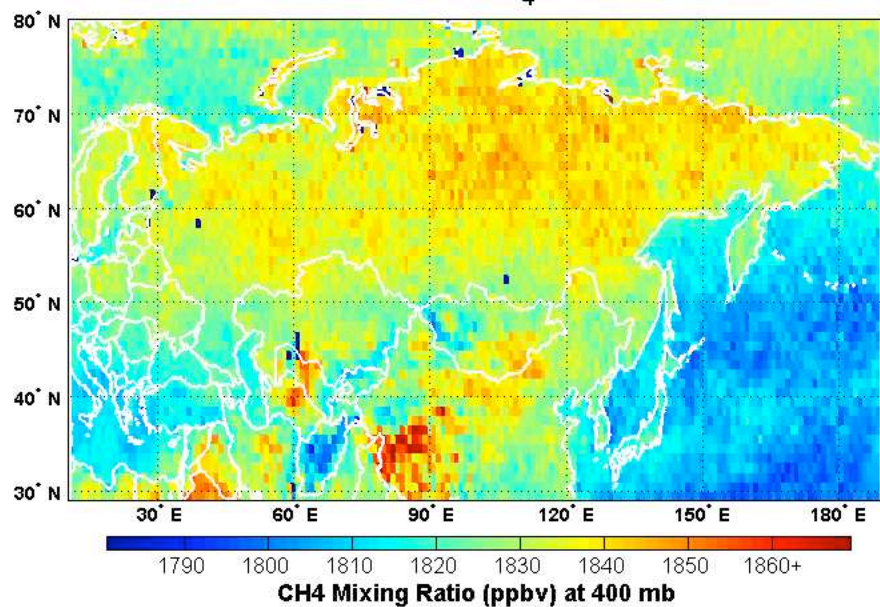
Local PM (ascending) AIRS CH₄ at 400 mb on 2005.08.



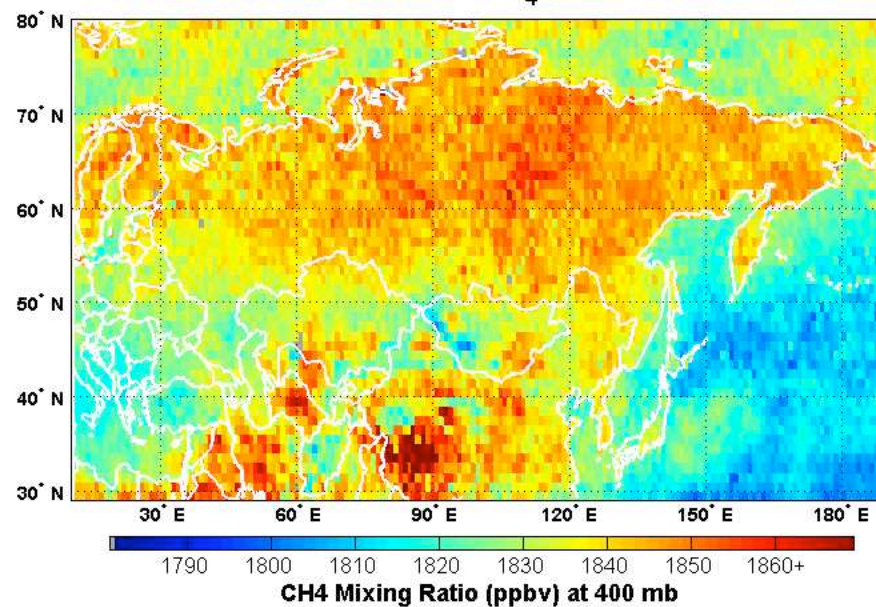
Local PM (ascending) AIRS CH₄ at 400 mb on 2006.08.



Local PM (ascending) AIRS CH₄ at 400 mb on 2007.08.

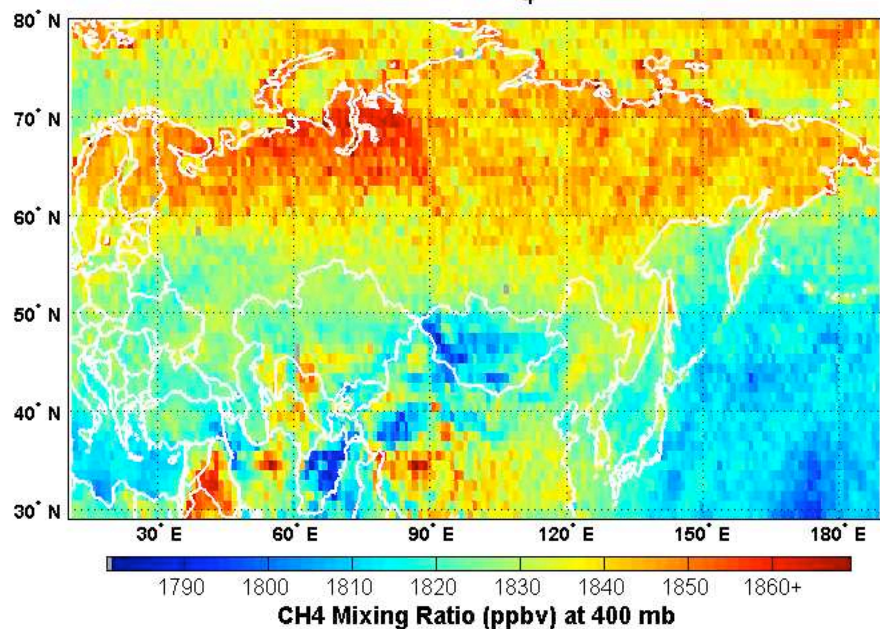


Local PM (ascending) AIRS CH₄ at 400 mb on 2008.08.

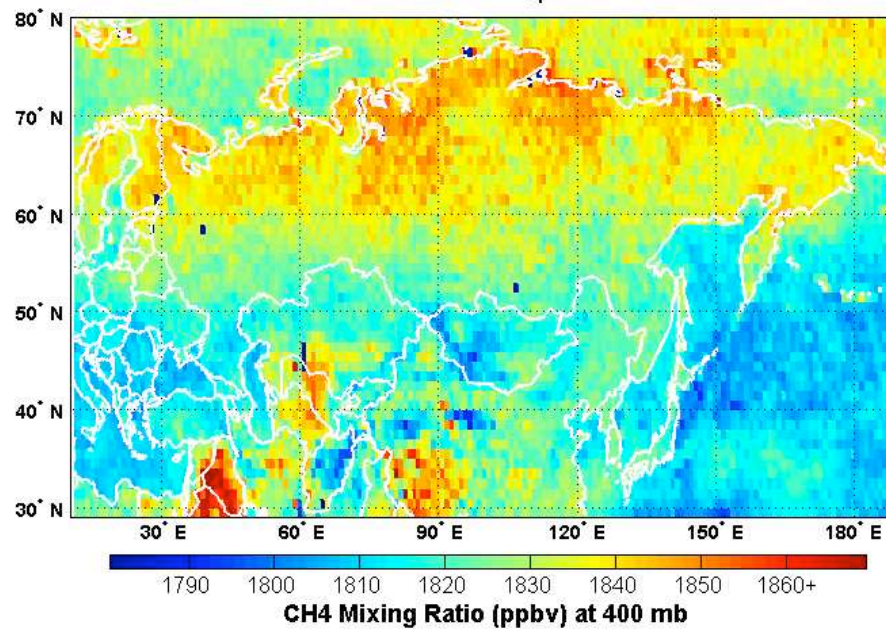


CH₄ in September between 2002 and 2007:
Tundra sources or marine sources (??)

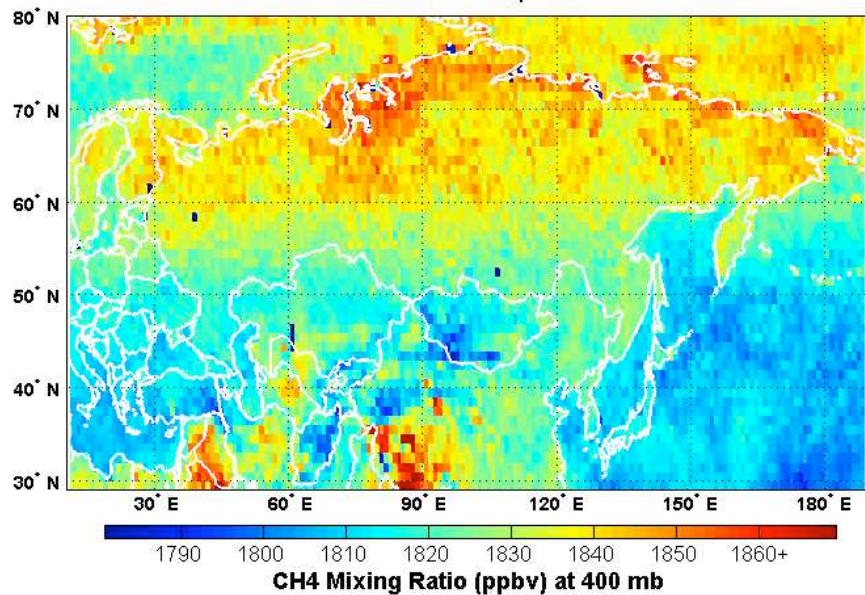
Local PM (ascending) AIRS CH₄ at 400 mb on 2002.09.



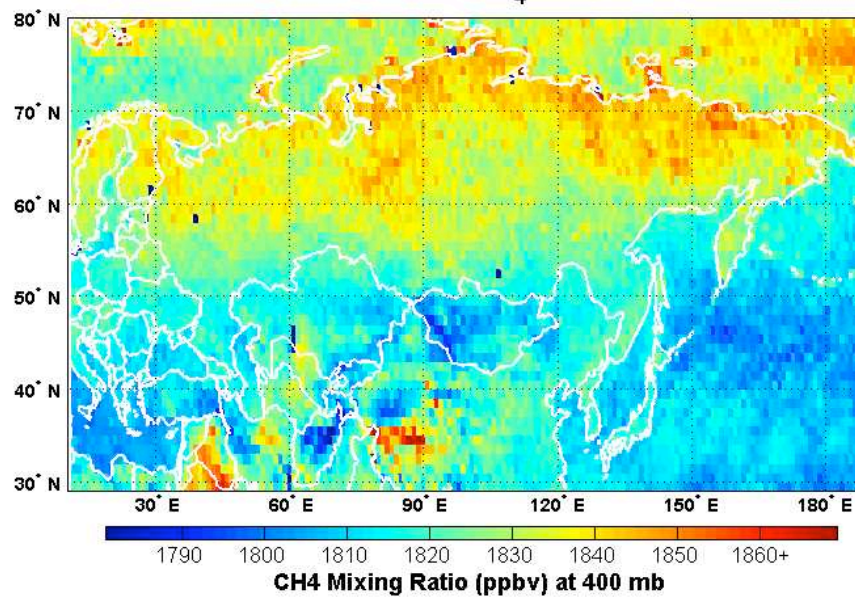
Local PM (ascending) AIRS CH₄ at 400 mb on 2003.09.



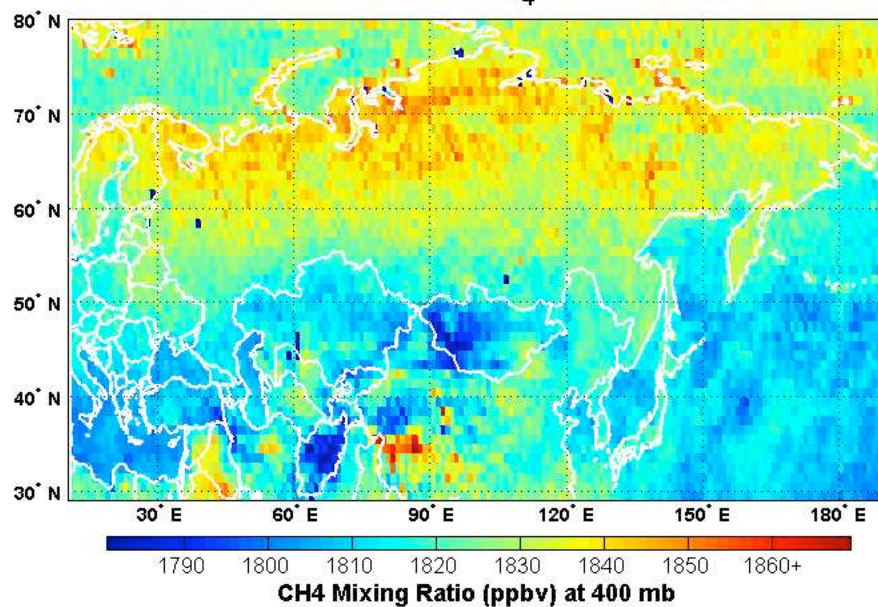
Local PM (ascending) AIRS CH₄ at 400 mb on .2004.09



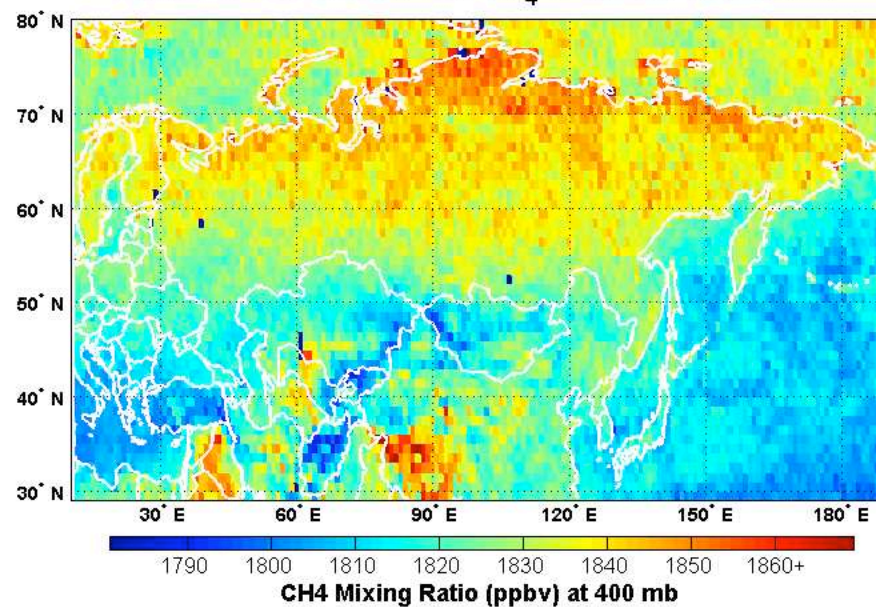
Local PM (ascending) AIRS CH₄ at 400 mb on 2005.09.



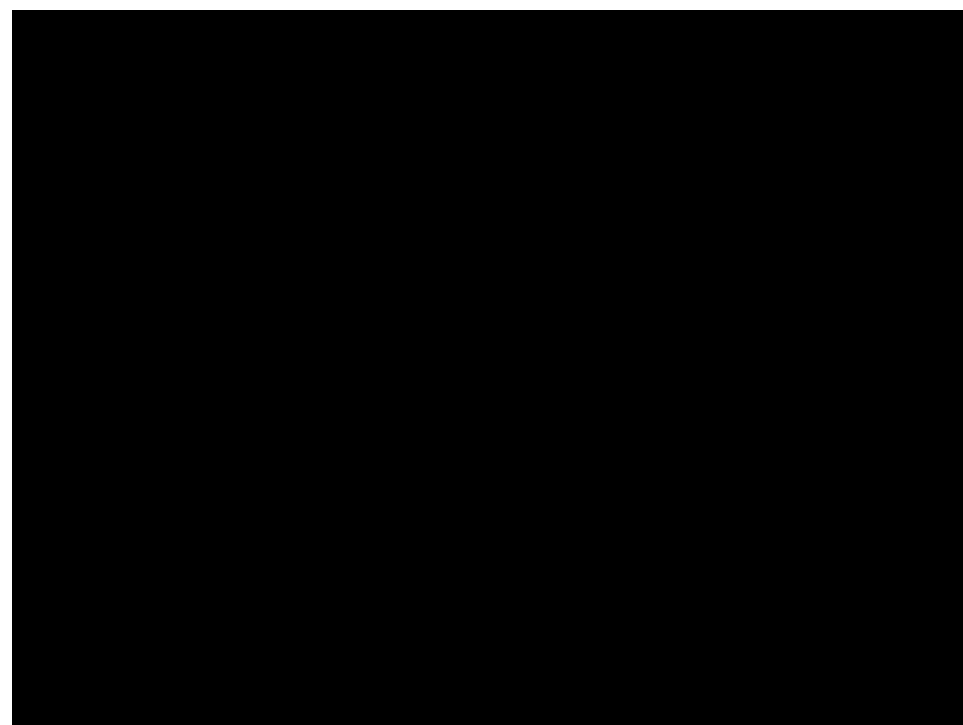
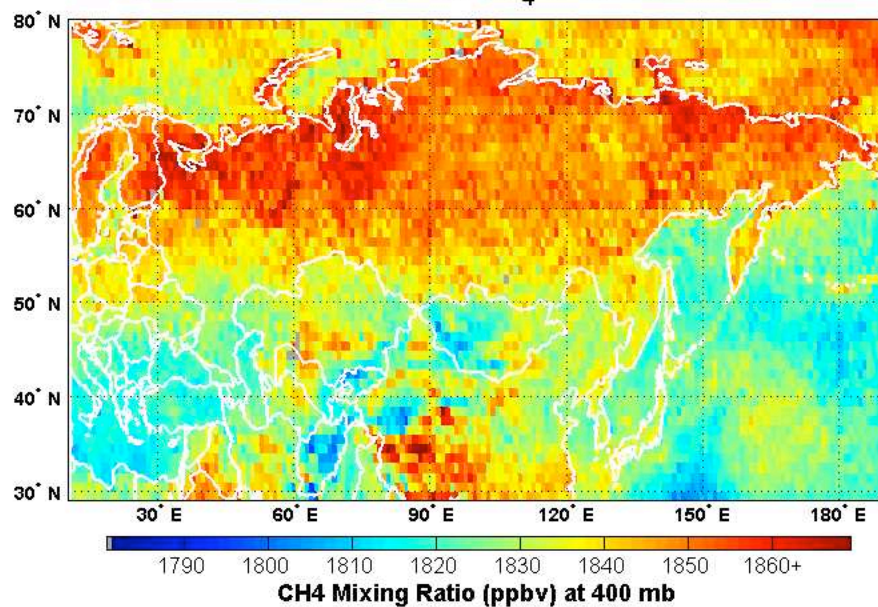
Local PM (ascending) AIRS CH₄ at 400 mb on 2006.09.

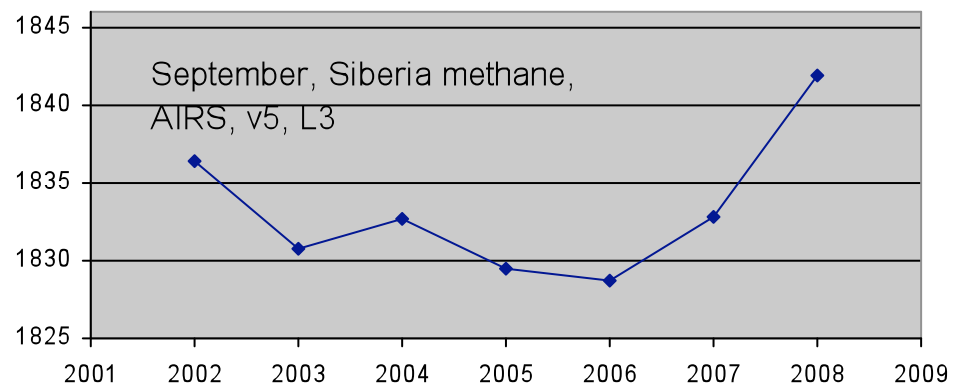
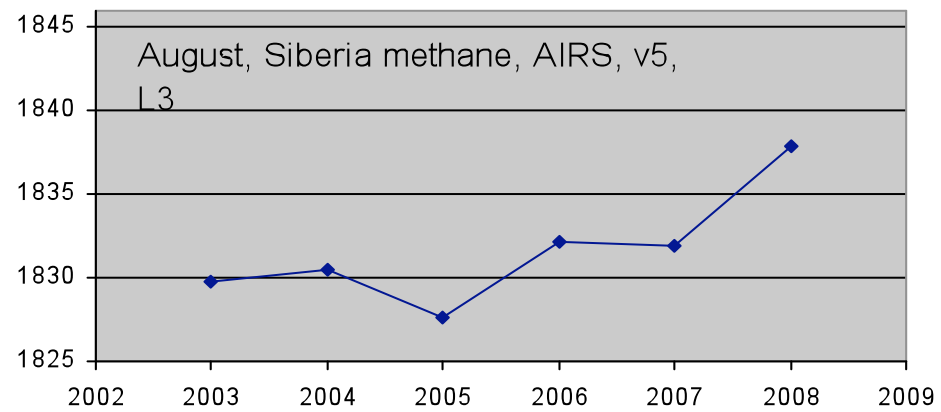
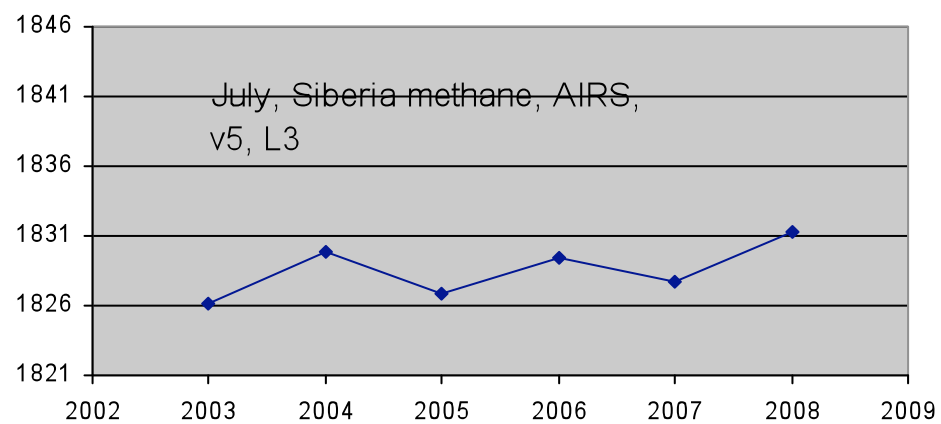


Local PM (ascending) AIRS CH₄ at 400 mb on 2007.09.



Local PM (ascending) AIRS CH₄ at 400 mb on 2008.09.





> Lenya, ya sobral nad Sibirskim shelfom okolo 70 prob
vozduha dlya opredeleniya izotopov metana.... Abnimayu, Igor
Igor! > > Spasibo, ya nashel. Soshlyus na tebya - ceychas idet
meeting AIRS science > group. Moshnost poschitayut modeliery.
> > Otdyhay. > Lenya > -- > Dr. Leonid Yurganov, > Senior
Research Scientist, JCET, UMBC, Physics dept., 1000 Hilltop
Circle, > Baltimore, MD 21250; > Lenya Privet! >> >> V
avguste Sentyabre mi nashli Novie moshnie polya CH₄ release
over the >> East Siberian shelf which is now in transition state.
>> >> A kakaya moshnostÂ'predpologaemogo istochnijka? >>
>> See Nature News , sept 23 >> >> Cheers, Igor

Published online 26 September 2008 | Nature | News

Fears surface over methane leaks Experts work to confirm source of gas bubbling from Arctic seabed.

British researchers found more than 250 plumes of methane bubbling up.

Preliminary data from two Arctic cruises suggest that rising temperatures are already causing substantial amounts of methane to be released from beneath the ocean floor.

In the past few weeks, scientists aboard the British research ship James Clark Ross have discovered more than 250 plumes of methane bubbling up along the continental margin northwest of Svalbard. The findings add to a similar discovery by a Russian team in August, that reported elevated methane concentrations near the Lena River delta, as part of the International Siberian Shelf Study (ISSS).

"We have observed increased methane concentrations in the Laptev Sea during several expeditions since the mid-1990s," says Igor Semiletov, who oversees the ISSS methane programme aboard the Russian research ship Jacob Smirnitskyi. "But the data set is extremely limited. Whether what we're seeing in the region is of any relevance for the global climate is mere speculation."

Could we trust to satellite data?

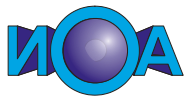
***In-situ* measurements in Western
Siberia are available!**

Spatio-temporal distribution of GHG in the surface atmospheric layer over Western Siberia

M.Yu. Arshinov¹, B.D. Belan¹, D.K. Davydov¹,

O.A. Krasnov¹, A.V. Fofonov¹

G.Inoue², T.Machida², Sh. Maksutov², K. Shimoyama²



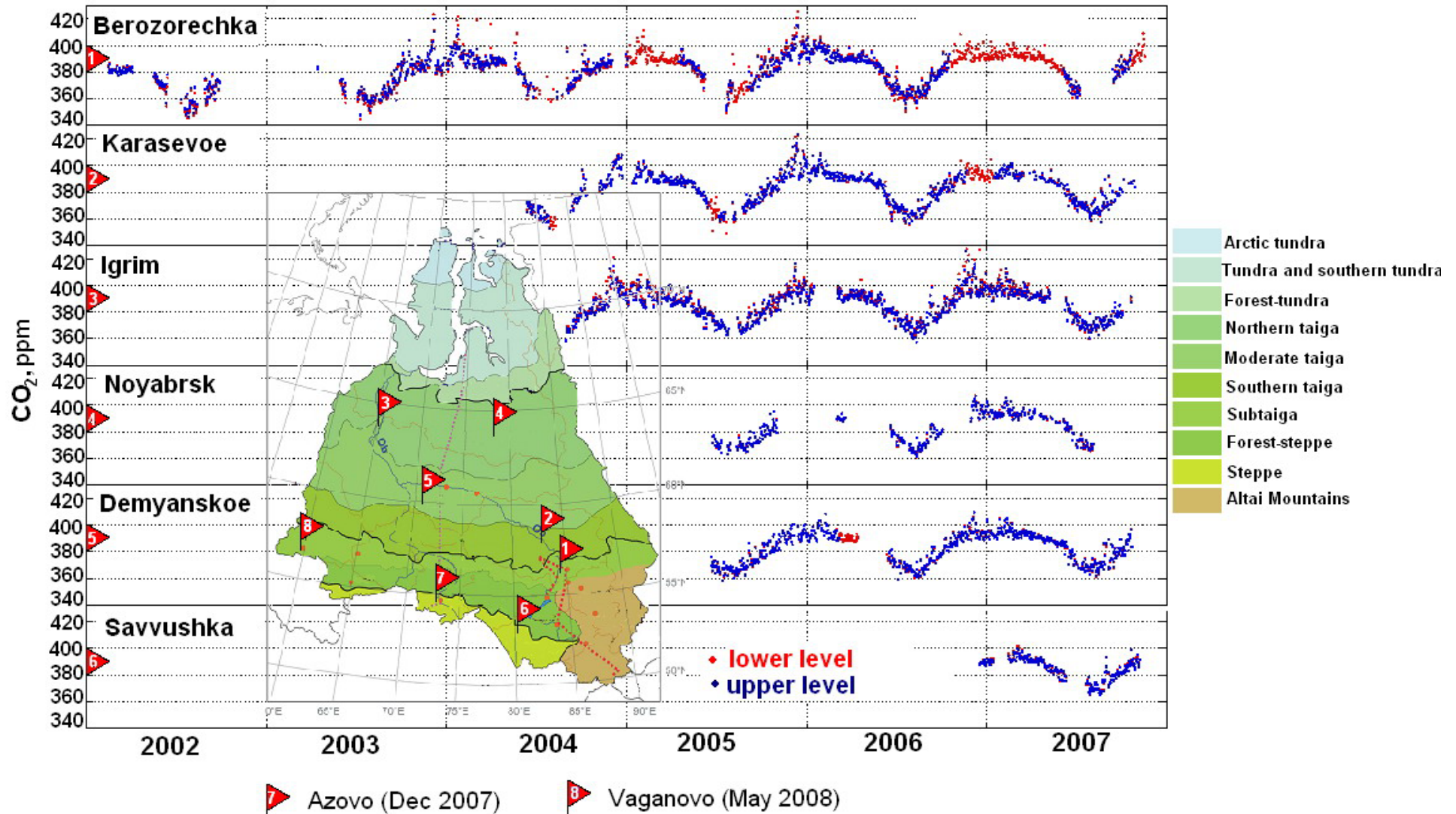
¹ Institute of Atmospheric Optics SB RAS, Russia



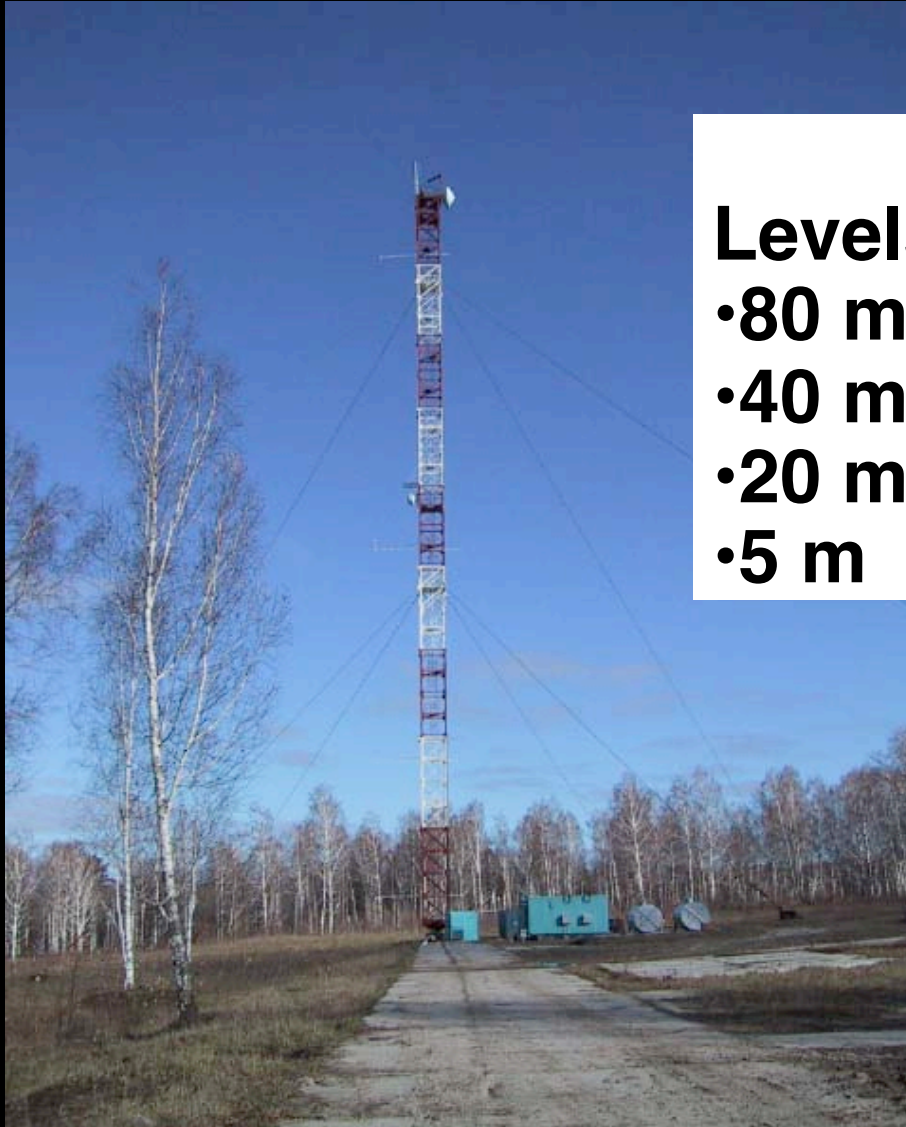
² National Institute for Environmental Studies, Japan

International Conference in Kislovodsk, Russia, 7 October 2008

GHG Monitoring Network in W. Siberia



Berezorechka Tower (pioneer system)



Levels:

- 80 m
- 40 m
- 20 m
- 5 m

Measured parameters:

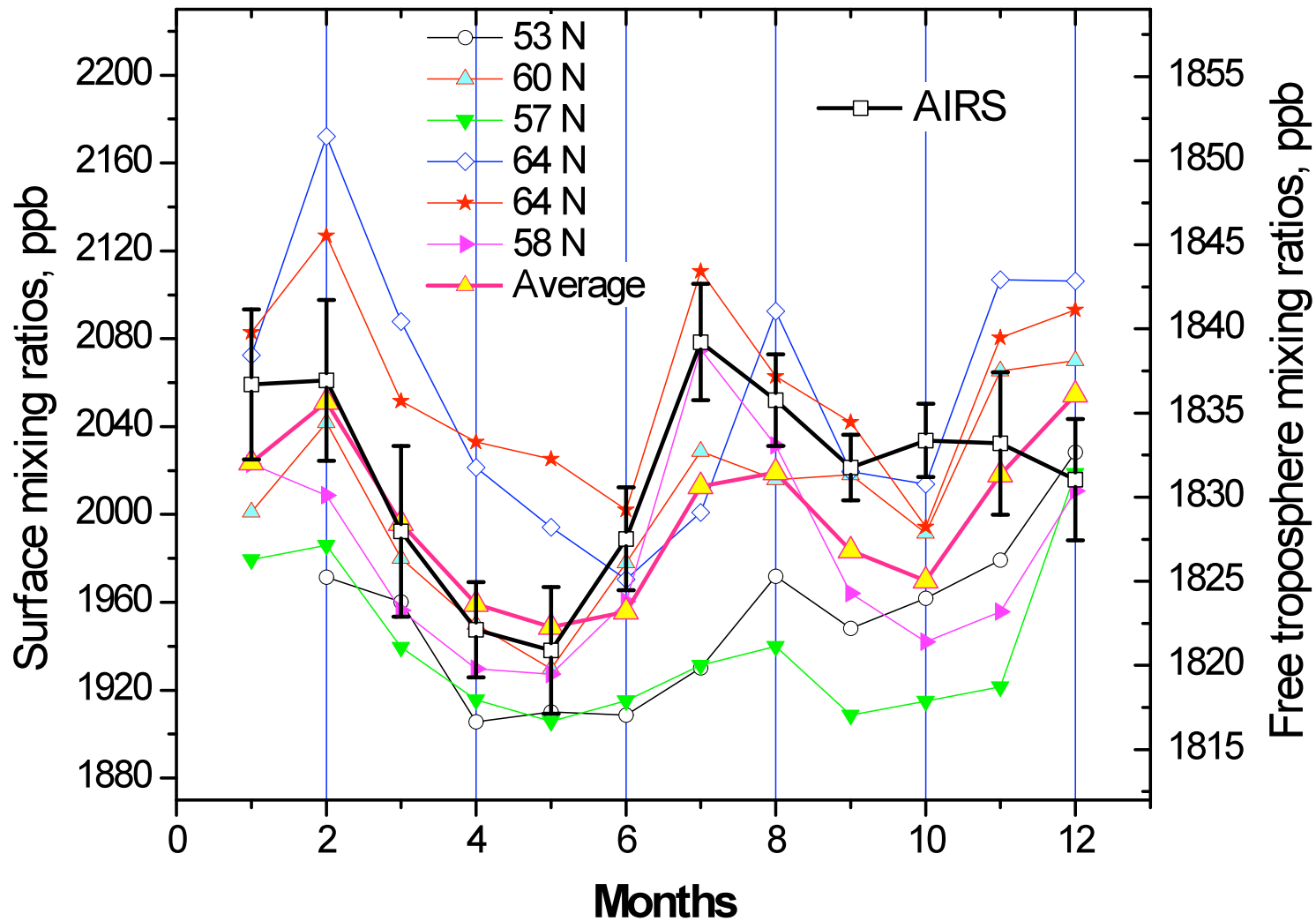
CO₂ concentration,

CH₄ concentration,

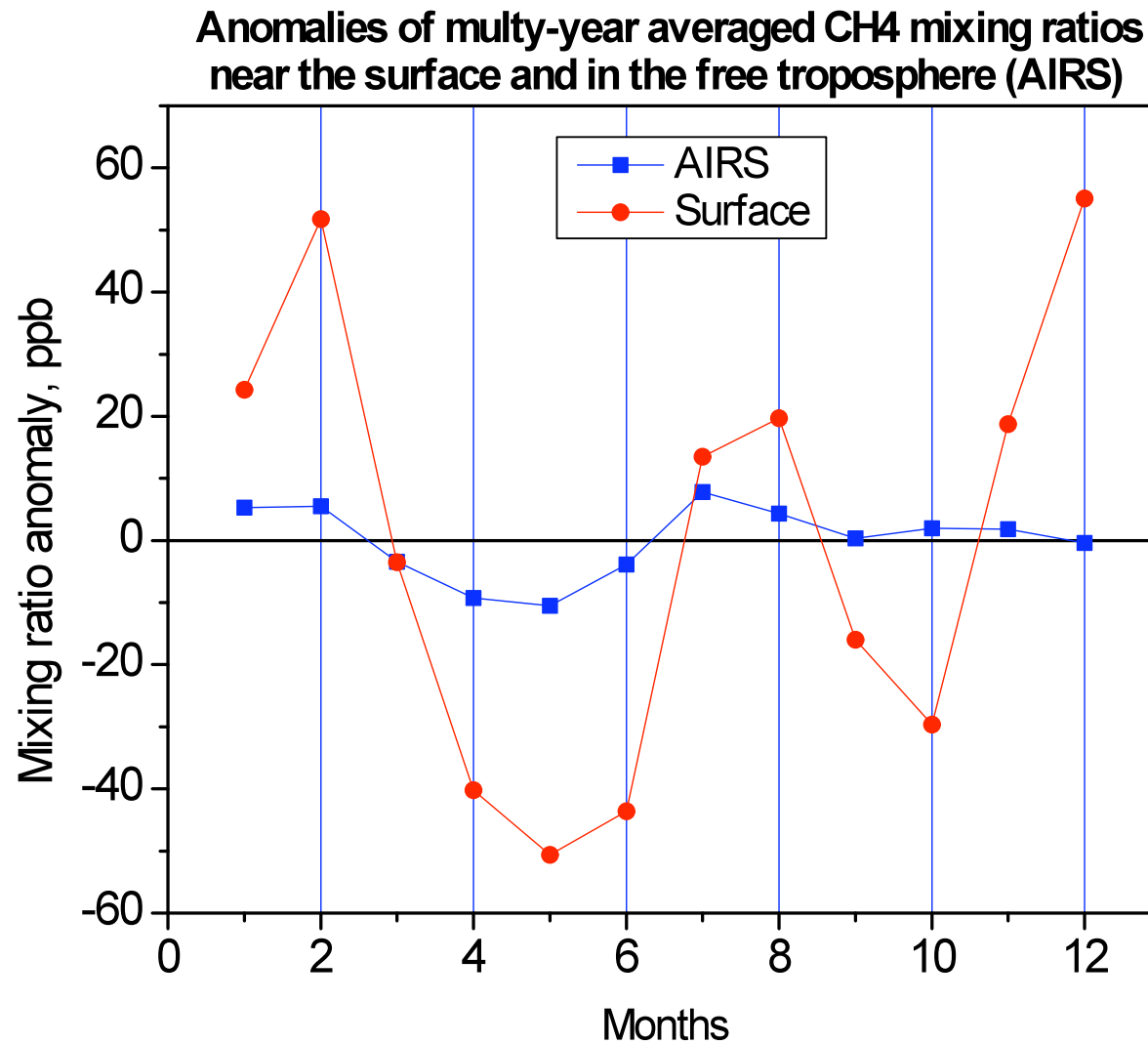
t and RH, wind velocity,
solar radiation,
precipitation, ambient
pressure

Comparison of AIRS (right scale) with surface data at 6 sites (left scale) 2003 - 2007

West Siberian AIRS CH₄ vs surface data (curtesy M. Arshinov, IAO)



Comparison of anomalies in the same scale



The “standard model” of methane emission from the West Siberian wetlands

Glagolev M.V. :

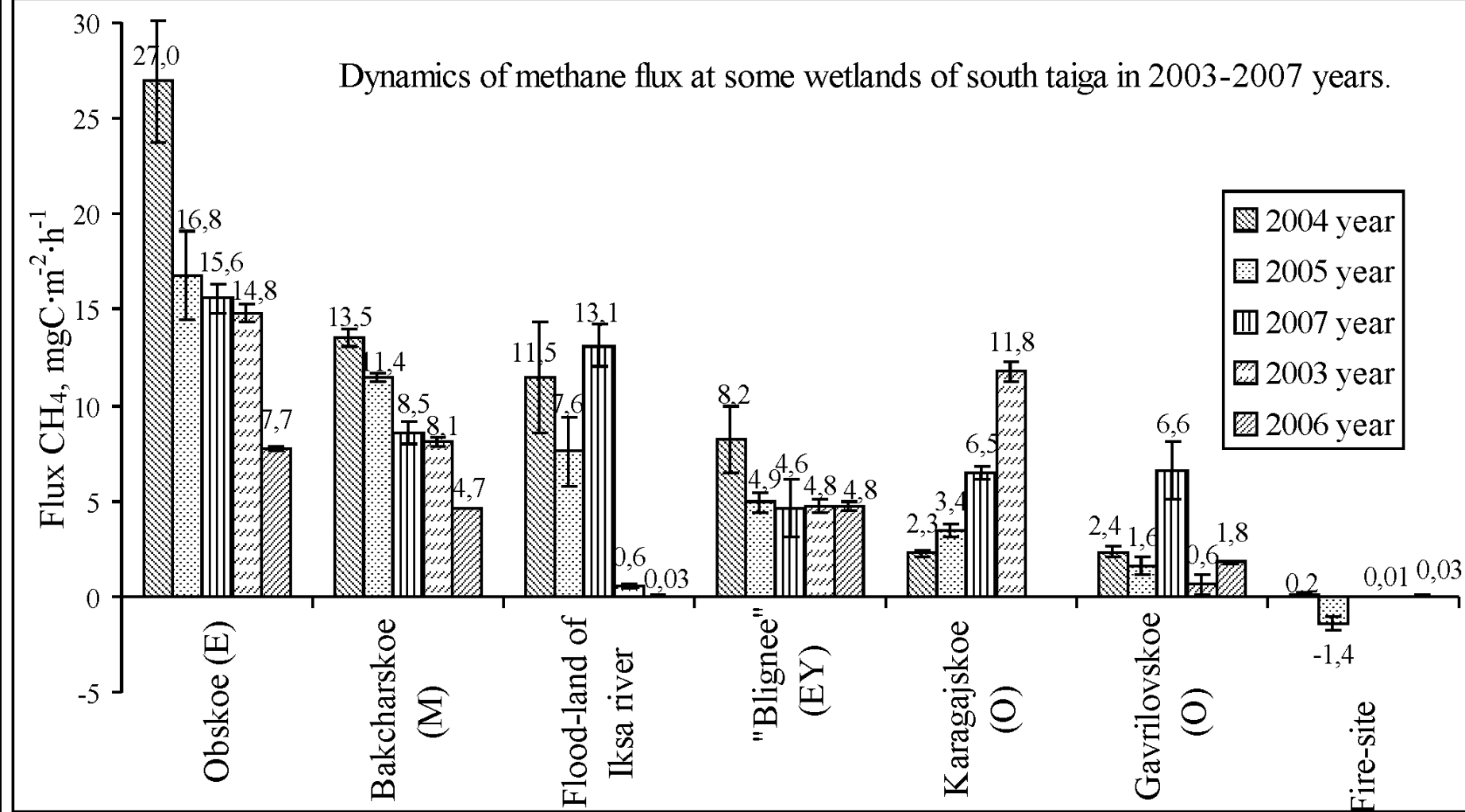
*Department of Soil Physics and Amelioration,
Moscow State University*



Principal methane flux measuring sites at territory of Russia



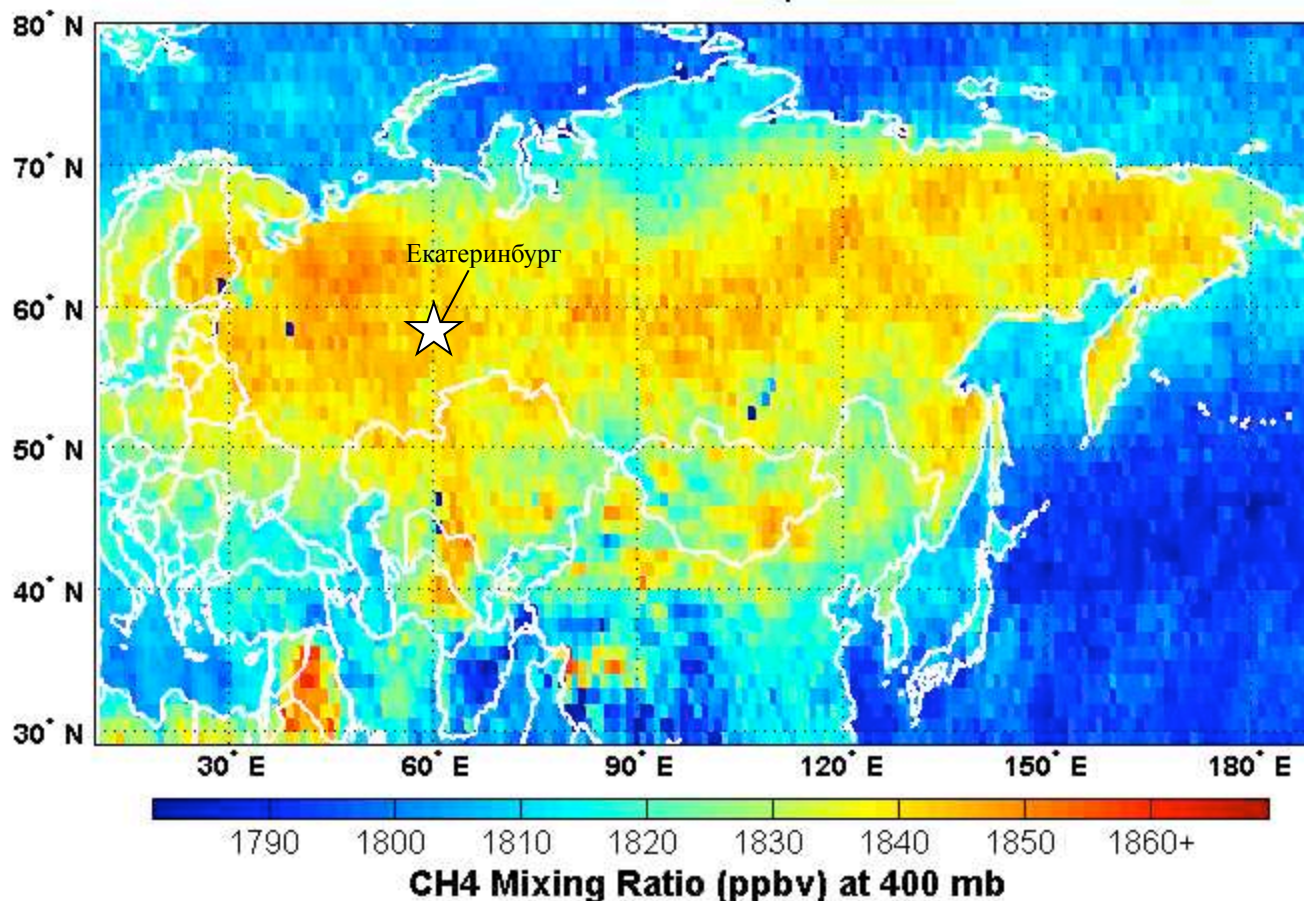
Dynamics of methane flux at some wetlands of south taiga in 2003-2007 years.



Sun-viewing FTS for validation

Location of a new Bruker 125HS FTS (0.003 cm⁻¹ resolution, 3800-20,000 cm⁻¹ spectral coverage)

Local PM (ascending) AIRS CH₄ at 400 mb on 2003.07.





Dr. Zakharov (PI) and Dr. Yurganov near the existing building of a solar telescope



Dr. Zakharov is inspecting the status of preparatory construction



A pit for a massive concrete pedestal for the interferometer
(it will be separated from the main building)

So!

- SCIAMACHY and AIRS supply reasonable CH₄ data, but they need to be validated and compared to independent surface data.
- Methane retrieval algorithm needs to be improved. In particular topographic influence should be investigated and fixed. Sensitivity to lower free troposphere and PBL might be increased. A subset for northern high latitudes looks promising.

- **According to AIRS, bacterial emission from wetlands maximizes in July, the warmest month of the year. It appears as an important CH₄ source on a global scale.**
- **A maximum of CH₄ over tundra (e.g., at Victoria and Banks islands in Canada) occurs in September: WHY?**
- **Secondary CH₄ maximum over Finland and Karelia is observed in October: WHY?**
- **Ground truth data from Russia are useful for both CH₄ and CO₂!**

**These questions will be a matter of
study for the future**

Thank you!